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VOLUME XI 1947

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SPRECKELS SUGAR BEET BULLETIN

PUBLISHED FOR CALIFORNIA SUGAR BEET GROWERS BY THE SPRECKELS SUGAR COMPANY

Vol. XI JANUARY - FEBRUARY 1947 No. 1

SUGAR BEET INSECTS

Insect damage to the California sugar beet crop is generally very light. Such damage as does occur is usually confined to a very limited area as most pests can be quickly brought under control if prompt and effective methods are employed.

Colored photographs of the insects most likely to attack sugar beets in California are reproduced in this issue of the Spreckels Sugar Beet Bulletin to aid in their identification. Description and recommended method of control accompany each photograph.

We are indebted to Dr. W. Harry Lange, Assistant Entomologist of the University of California, for his assistance in preparing the descriptions and methods of control of the pests and securing some of the specimens used for photographing. Mr. E. A. Schwing, entomologist for the beet sugar companies, also assisted in the collection of the specimens.

This issue on sugar beet insects is a companion to the January-February 1945 Bulletin, in which colored reproductions of the principal sugar beet diseases in California were discussed. J. E. Coke, Spreckels Sugar Company.

SUGAR BEET INSECTS AND NEMATODES AND THEIR CONTROL

W. HARRY LANGE, *Assistant Entomologist*
University of California

Decreased yields of sugar beets on individual fields may often be attributable to one or more insect or nematode pests. Certain insects such as aphids and leafhoppers may be the vectors of plant diseases which often reduce sugar beet production. In order to properly evaluate the relative importance of these insect and nematode problems it is highly desirable that all concerned in growing sugar beets be able to recognize the pests involved, their type of injury, and the best method for their control. Most losses caused by these pests can be reduced to a minimum through the use of one or more measures. These include good farming operations, good cultural and sanitation practices, planting resistant varieties, the use of rotations which reduce the abundance of a particular pest, or the use of soil fumigants or other chemicals.

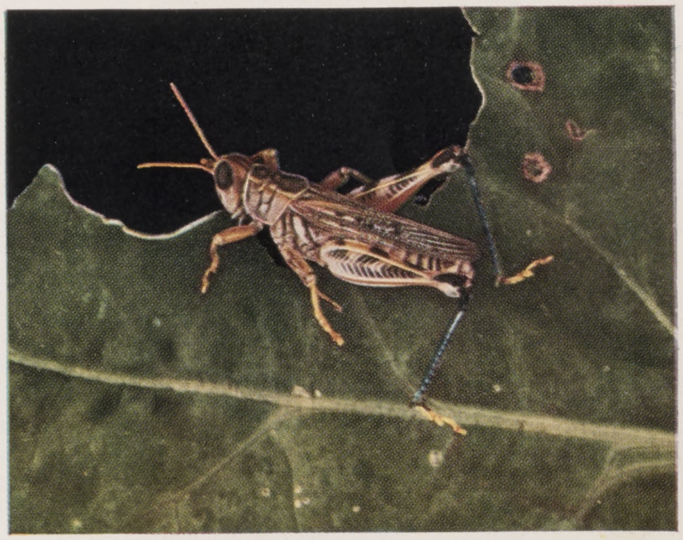
DR. W. HARRY LANGE

The recent appearance of DDT, D-D, and other similar chlorinated hydrocarbons has given a tremendous impetus to the chemical control of sugar beet pests, particularly those inhabiting the soil. DDT, for example, has proven very effective for leafhopper control, while D-D and ethylene dibromide are proving of value as soil fumigants for the control of nematodes and soil inhabiting insects. A new material, hexachlorocyclohexane, is controlling many insects which cannot be controlled by DDT, and has value as a soil insecticide. A new aphicide, the hexaethyl ester of tetraphosphoric acid (Bladan) has appeared in recent months.

From the standpoint of the grower the pests affecting sugar beets can be divided into those which are present in or about the fields at the time of planting and those which migrate into the fields from the outside. Pests already in the fields at the time of planting are chiefly soil inhabitants and include wireworms, nematodes, larvae of diabrotica beetles, cutworms, armyworms, garden centipedes and others; those pests which migrate into the fields and feed chiefly above ground include the beet leafhopper, adults of diabrotica beetles, grasshoppers, aphids, thrips, false chinch bugs, webworms, flea beetles, and others. A few insects such as the sugar beet root aphid can be present in the fields at the time of planting or can come in later to cause damage. Past insect and nematode histories of fields

(Continued on page 8)

VALLEY GRASSHOPPER



See page 3 for discussion.

HONEY-DEW

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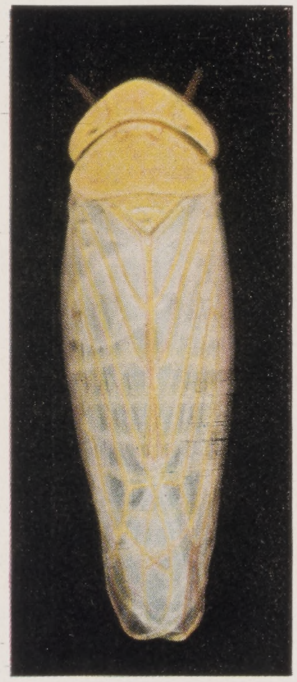

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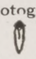
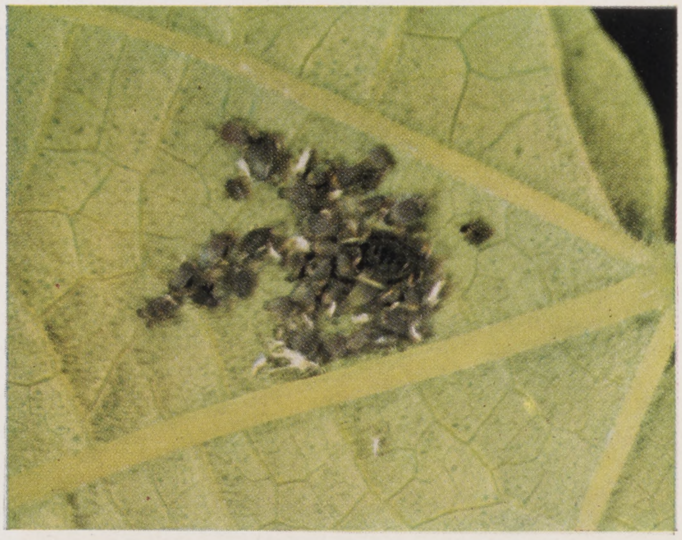
 = Actual size

BEET LEAF HOPPER

"Curlytop" or "blight," a virus disease of beets, is transmitted by a small leafhopper, *Eutettix tenellus* Baker. The adults are one-eighth inch long, pale green in spring, cream colored in summer, and in winter are dark colored with darker markings on the wing covers. The disease is characterized by the rolling in of the leaf margins, the young leaves show transparent venation, and a warty condition develops on the backs of the veins. In addition, the roots may become hairy and dark rings show in cross sections of the roots. The winter brood of leafhoppers returns to the foothills in the fall, exists on perennials until rains sprout the annuals, then lays eggs on the annuals. Eggs hatch through the winter and the spring dispersal from the uncultivated plains and foothills occurs after the pasture vegetation becomes dry. From two to four generations of the leafhopper can occur on lowland vegetation. Summer dispersals of leafhoppers can also occur. Control consists of destroying Russian thistle, the chief host plant for overwintering leafhoppers, and spraying the annuals such as red-stem filaree in the foothills before the spring dispersal flights. Resistant varieties have been developed which assist in averting serious injury, and early planting is recommended so that the beets are well established before infection occurs. DDT both as dusts and sprays can be used in the fields in the spring to reduce the numbers of leafhoppers in the fields.

THE BEAN APHID

Small, black "lice" or aphids on sugar beets in the spring are often the **bean or dock aphid,** *Aphis rumicis* Linnaeus. These aphids are the commonest dull black species. They overwinter on euonymus and dock and then winged forms migrate in the spring to sugar beets, spinach, poppy, thistles, vetch, and many other hosts. Often aphids will move to beets from nearby fields of horse beans and similar plants. Usually it is not necessary to dust, but if needed, a nicotine dust is usually effective.



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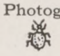
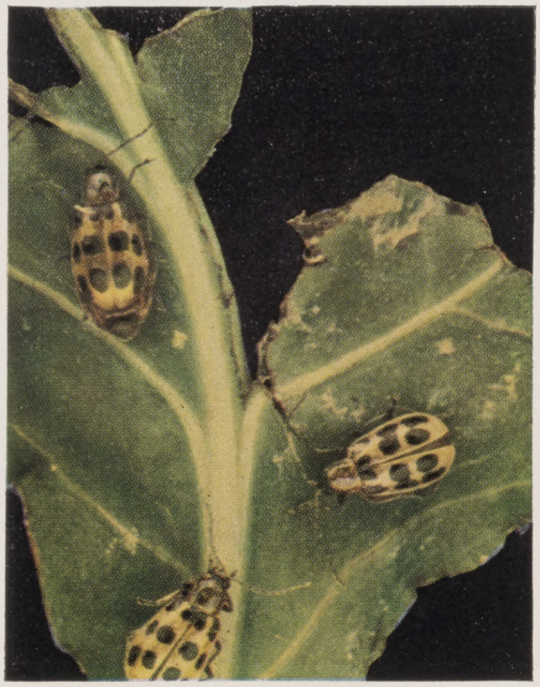
 = Actual size

THE WESTERN TWELVE-SPOTTED CUCUMBER BEETLE



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Irregularly chewed holes in the leaves of beets with black excrement spots around the damaged areas, often indicates feeding by the adults of the **western twelve-spotted cucumber beetle,** *Diabrotica 11-punctata* (Mannerheim). In the spring occasional damage is done by the feeding of these green and black spotted beetles. Hibernating adults lay eggs in the spring, eggs hatch and larvae feed on the roots of numerous grasses, weeds, and cultivated plants. Migrations of adults often occur from those emerging in foothills. Pupation occurs near the surface in small earthen cells. Several broods occur a year. The active larvae are whitish with a distinct black, anal plate and often kill small beets from February to May by feeding on the main top root. Larvae also feed on mature beets, the damage appearing as small, scooped out areas, which later turn reddish. Adults can be controlled by dusting with cryolite or DDT. In certain areas larval damage will occur in the spring when beets are planted after discing under alfalfa, cover crops, or weeds. Larval damage to sugar beets is insignificant.

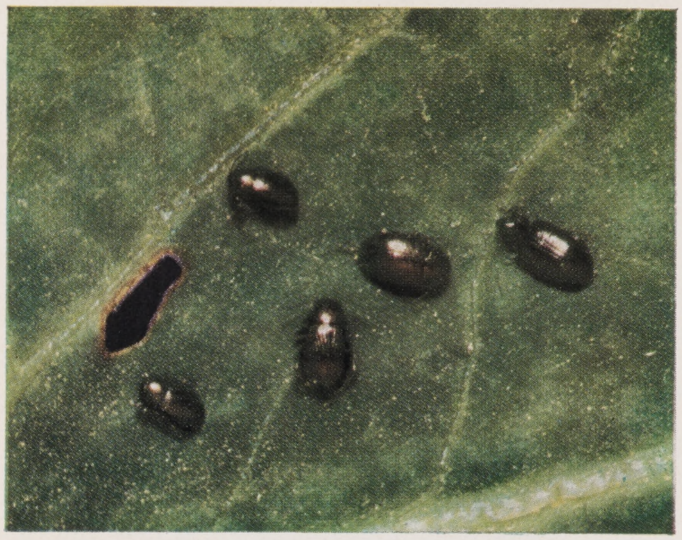
GRASSHOPPERS

Grasshoppers occasionally damage sugar beets when they move into fields from alfalfa or from drying native vegetation.

The **valley grasshopper,** *Oedaleonotus enigma* Scudder (see photograph), attacks all types of vegetation. The adults are 1 inch long, of a yellowish-brown or amber color and with darker markings on the wing cases, legs, and body. The tibiae are pale blue. The eggs are laid from August to October and the young hatch in the spring and mature in June. Control at the source of the migration is desirable. Poison baits, similar to the one given under the variegated cutworm, can be used in the fields at the rate of 20 pounds per acre, or less in open country. One quart of sodium arsenite can be used to the 25 pounds of bran, and sawdust can be substituted to the extent of 3/4 by volume. Sodium fluosilicate at the rate of 1 1/2 pounds can also be used. Migrating grasshoppers can often be trapped in ditches along the edges of fields. Recent work with DDT and a new chemical "1068" would indicate that these materials may offer control in the future.

The differential grasshopper, *Melanoplus differentalis* (Thomas), is a larger species attaining a length of 2 inches. The adults are chiefly amber or yellowish-brown, with the yellow femora crossed with black cross lines, and the tibiae yellow to red. The nymphs are green. The eggs are laid in midsummer, hatch in the spring, and hoppers mature in June. Damage may occur until August. They prefer rank vegetation and often move from alfalfa fields to sugar beets. Control is the same as for the valley grasshopper.

FLEA BEETLES



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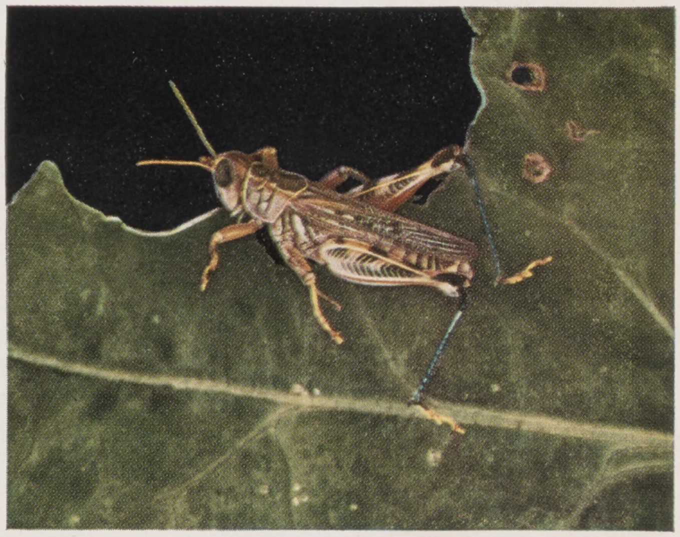
Flea Beetles, *Hemiglyptus basalis* (Crotch), *Haltica* spp., *Chaetocnemis* spp. (see photograph), and others, occasionally eat holes in sugar beet leaves in the spring. Control is seldom necessary, although a DDT dust is effective on most species.

VALLEY GRASSHOPPER



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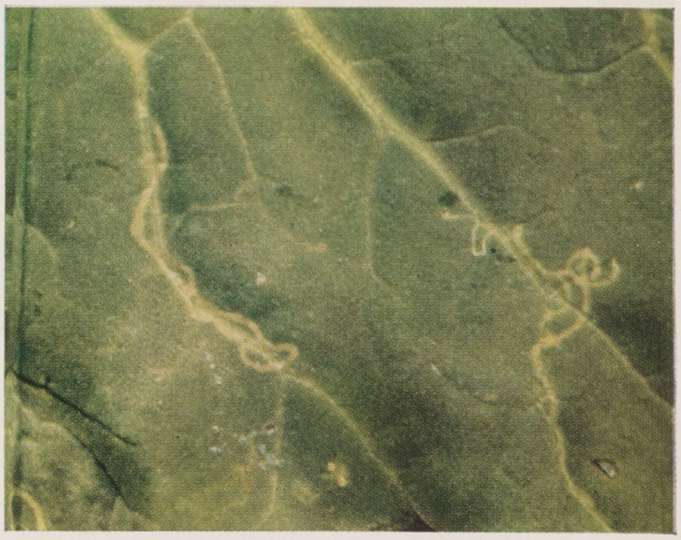
LEAF MINING FLIES

Occasional damage to sugar beets is caused by mining of leaves by maggots of the **pea leaf miner,** *Liriomyza orbona* (Meigen). The small, serpentine mines are very numerous on leaves of sugar beets, and under most conditions no damage is done. A generation is completed in 30 days during summer, and the larvae pupate in small oval, yellowish-brown puparia in the soil. Sugar beets breed up large numbers of flies which often migrate to nearby peas and melons. All types of plants are selected by this miner. No control is known, or usually necessary. A number of hymenopterous parasites usually keep the fly under control.

The beet or spinach leaf miner, *Pegomya hyoscyami* (Panzer) is a familiar insect on beets in California, although it seldom causes any economic damage to beets. The maggots form large blotch mines, and the larvae drop out to the ground where they pupate. In severe infestations entire leaves may be destroyed. This is an introduced species from Europe. Usually no control is necessary. Clean culture and crop rotations may prove of some value.

PEA LEAF MINER



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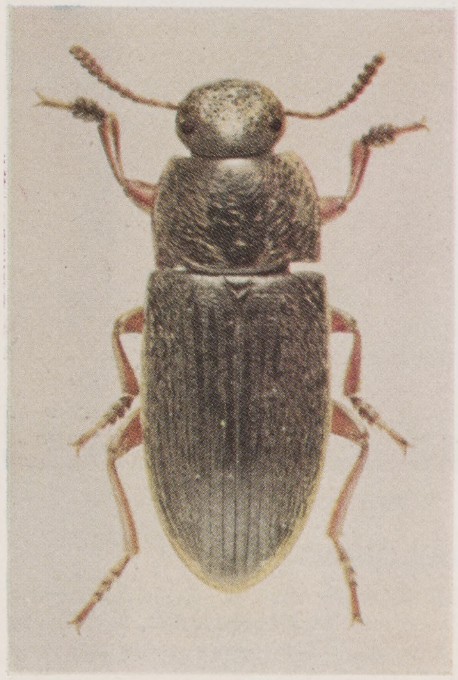
BLAPSTINUS BEETLE

Small darkling ground beetles of the genus *Blapstinus* (*B. fuliginosus* Casey, and others) often girdle or cut off the small beets in the spring and early summer, causing the loss of many plants. Unlike wireworms, the larvae prefer drier soil and feed on decayed organic matter in the soil or occasionally the roots of living plants. A bran mash as mentioned under cutworms is usually a satisfactory means of control.



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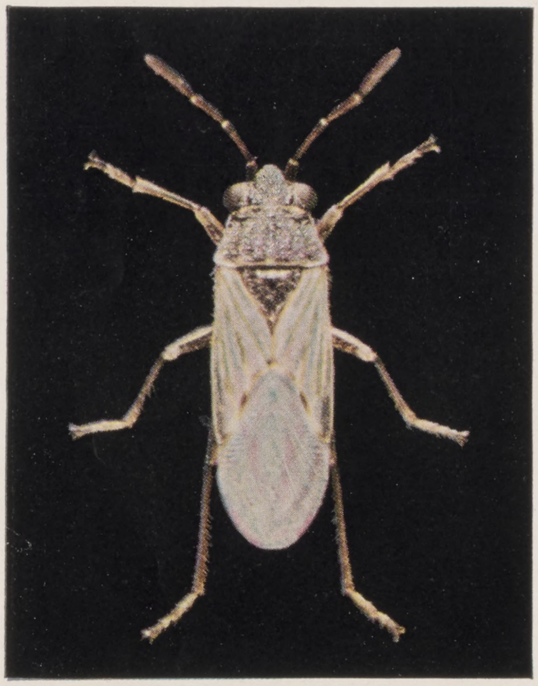
THE FALSE CHINCH BUG

Adults and nymphs of the **false chinch bug,** *Nysius ericae* (Schilling) and *Nysius ericae minutus* Uhler (see photograph), occasionally swarm from grasses and weeds in the spring when they come out of hibernation, and move to sugar beets. These bugs suck juices from the plants and can cause considerable damage. All stages overwinter, although nymphs predominate. Nicotine and soap sprays or DDT dusts or sprays can be used to control these insects. The use of ditches or other barriers can be used to trap the migrating nymphs.



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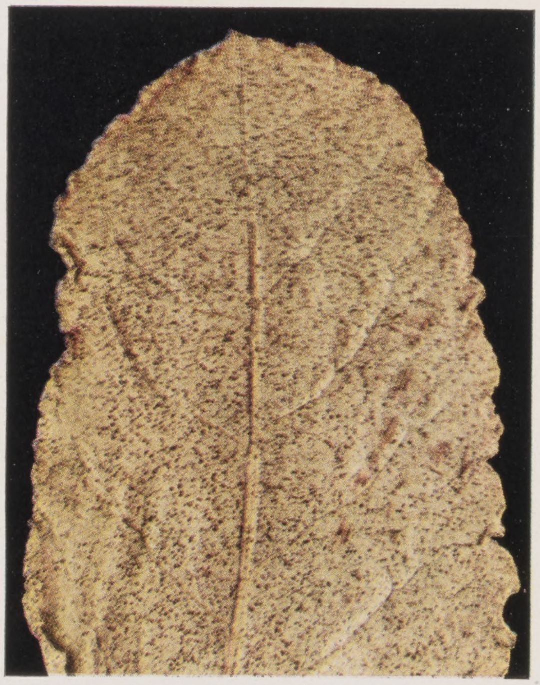
BEAN THRIPS



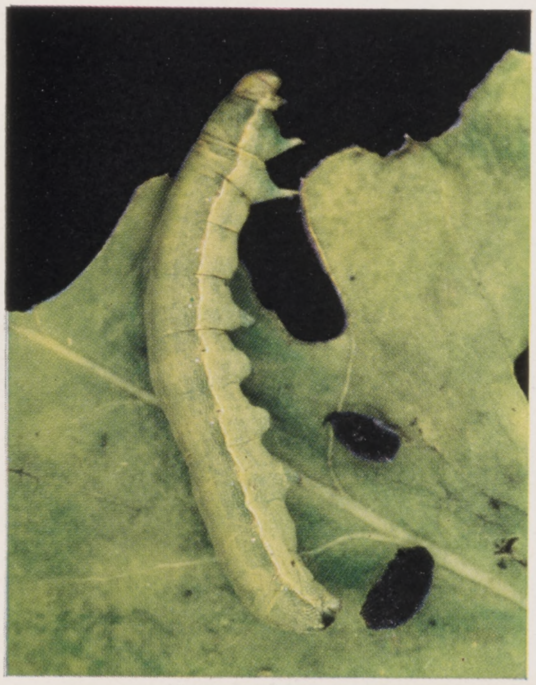
The silvering and black-spotting of the under surfaces of sugar beet leaves is often due to the feeding of the **bean thrips,** *Hercothrips fasciatus* (Pergande) (see photograph). The larvae are reddish yellow or pink and the adults are 1/25 inch long, with the fore wings characteristically banded with two light and two dark areas. There are several generations a year with pupation occurring in the soil. Weed control is of value in controlling this thrips as prickly lettuce and annual sow thistle are preferred hosts. DDT and sulfur dust may prove effective. In California the sugar beet thrips, *Hercothrips femoralis* Reuter, occurs chiefly on sugar beets in greenhouses.

CUTWORMS AND ARMYWORMS

Cutworms and armyworms are the larvae of noctuid moths or millers (family Phalaenidae or Noctuidae) and those affecting beets are characterized by their smooth bodies with few hairs and with five pairs of abdominal prolegs in addition to the three pairs of true legs. A few of the more important species feeding on beets follow:

The **beet armyworm,** *Laphygma exigua* Hübner (see photograph), is one of our most destructive species. The moth is mottled gray with light markings and has a wing expanse of 1 to 1¼ inches. The worms have several color phases ranging from green to purplish, but the commonest are pale olive green with a dorsal stripe down the back and a lateral pale stripe in each side. Three broods occur in California: the first appears in late April or early May and usually develops along ditch banks or other similar places; the second brood appears in late June or early July and is the most important brood on beets; and the third brood appears in September and usually does little damage to beets. The caterpillars defoliate sugar beets and cause extensive damage in certain years. The larvae can be controlled by early applications of DDT, cryolite, or calcium arsenate dusts at the rate of 20 pounds to the acre. Migrating worms can be trapped in a ditch with steep sides, using crude oil in the bottom. Often larvae are killed by diseases and damage is averted.

BEET ARMYWORM



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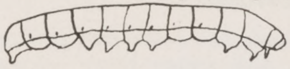

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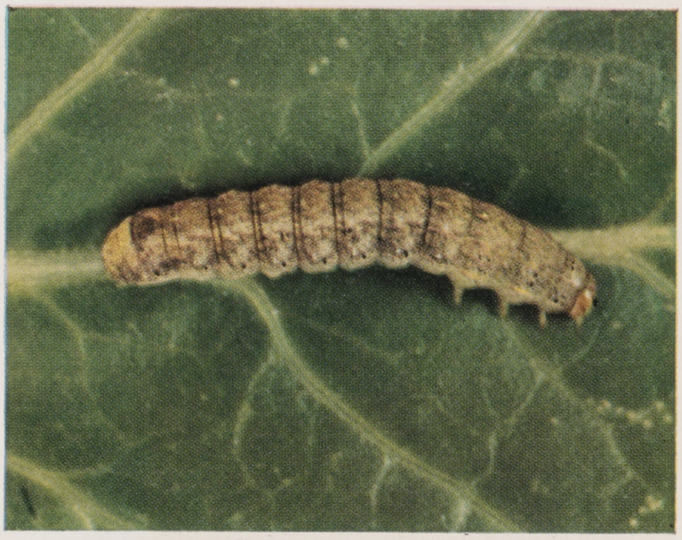
VARIEGATED CUTWORM



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The **variegated cutworm,** *Peridroma margaritosa* (Haworth) (see photograph), is one of our commonest cutworms, attacking a variety of hosts. The moth is night flying, grayish-brown with lighter markings, with an expanse of 1½ to 2 inches. Eggs are laid in large clusters on foliage, tree trunks or any convenient location. The mature worms attain a length of 1½ to 2 inches and are easily distinguished by the dorsal row of light-colored diamond-shaped markings. Pupation occurs in the soil, and at least two broods occur. Unlike many true cutworms, the worms often remain above ground during the day inside cabbages or other plants offering a protected location. Damage to beets is done at night when the larvae cut off the small plants at the ground level.

Control consists in using a poison bait which can be prepared as follows:

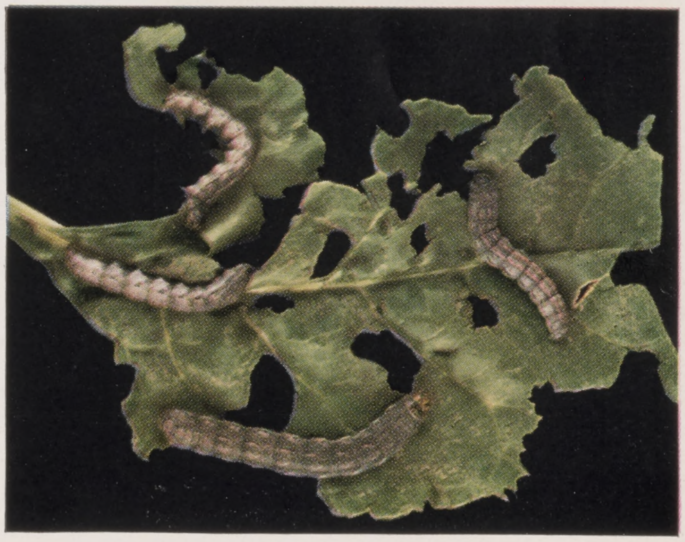
Paris green (or arsenic trioxide)	1 pound
Bran	25 pounds
Molasses	2 quarts
Water	Sufficient to make a dry mash

In preparing the bait, the poison and bran is thoroughly mixed dry. Dissolve the molasses in a little water and add to the dry mixture while stirring. Continue to add water until a crumbly mash consistency is reached. In the above formula sodium fluosilicate may be used at the rate of ½ pound as a substitute for Paris green, or calcium arsenate can be used at the rate of 1¼ pounds. Usually 20 to 30 pounds of bait per acre is necessary, and the bait should be spread toward evening to obtain best results.

The **greasy cutworm,** *Agrotis ypsilon* (Rottenburg) (see photograph), is another widely distributed species. The adults are very similar in appearance to the variegated cutworm. The caterpillars are 1½ to 2 inches long,

(Continued on next page)

GREASY CUTWORM



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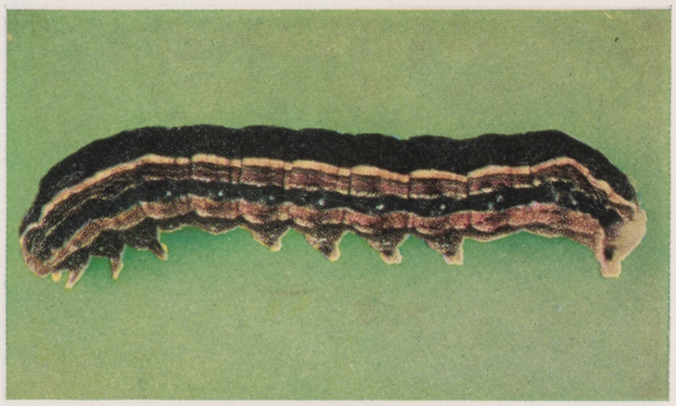
GREASY CUTWORM *(Continued)*

dull brown to black in color, and the entire surface is shiny and greasy in appearance. Mature larvae or pupae over-winter, laying eggs in the spring. At least two broods occur each year. The caterpillars are typical cutworms, cutting off young beets at night and retreating into the soil during the day. Control is best accomplished through the use of poison bran baits as given under the variegated cutworm.

Another common armyworm is the **yellow striped armyworm,** *Prodenia praefica* Grote (see photograph). The adults are night fliers, gray to brown in color with light silvery-gray hind wings, and a wing expanse of 1½ inches. The larvae are easily distinguished by the velvety black color with yellow stripes along the sides. Several broods occur; the July brood is the most serious, defoliating sugar beets in a manner similar to the beet armyworm. Control is the same as for the beet armyworm.

YELLOW STRIPED ARMYWORM



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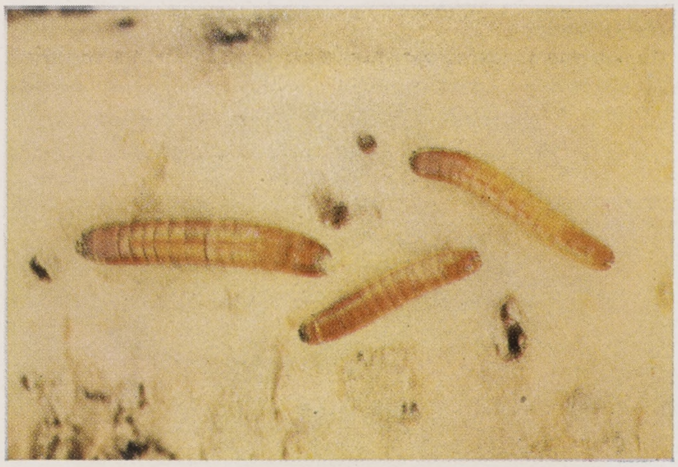
WIREWORMS

Thinned out stands of beets are often due to the feeding of wireworms, chiefly the **sugar-beet wireworm,** *Limonius californicus* (Mannerheim) (see photograph); the Pacific Coast wireworm, *L. canus* Leconte; the western field wireworm, *L. infuscatus* Motschulsky, and the wireworm, *Melanotus longulus* (Leconte). Wireworms, which derive their name from their cylindrical, shiny bodies, are the larvae of click or snapping beetles. The adult beetles which spread the infestations usually emerge in the spring, mate, and the females lay eggs in the soil which hatch into wireworms. One to several years are spent in the worm stage, then pupation occurs and adults emerge, completing the cycle. The new soil fumigants, ethylene dibromide and D-D, have been found effective for wireworms when used prior to growing a crop. With D-D, 400 pounds per acre are used, drilled into the ground at a depth of 6 to 8 inches, and at 12-inch spacings. With ethylene dibromide, 20 gallons of a 10 per cent mixture is necessary. New equipment is available to apply these chemicals. Plowing in the fall often destroys pupae. Planting early and using extra seed often will avert serious injury even in badly infested fields.

SUGAR BEET WIREWORM



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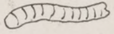

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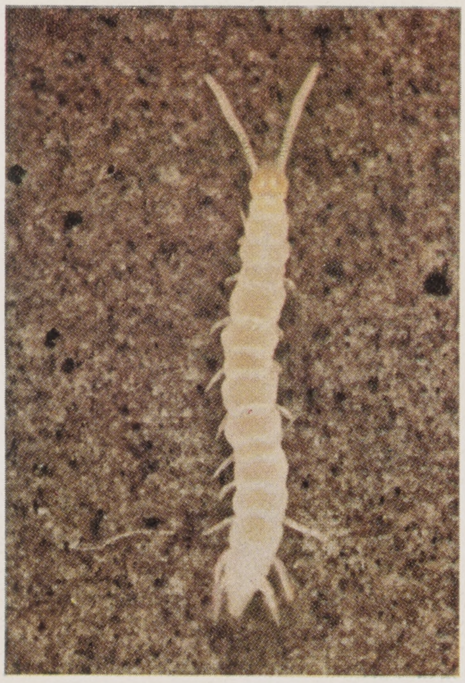
The **garden centipede,** *Scutigerella immaculata* (Newport), is a small, white, many-legged, active pest which lives in the soil and damages sugar beets and other crops. Eggs are laid in the spring, and adults can live several years. Damage is caused to the germinating seeds and to the young beets. The centipedes feed on the root hairs on the main root, stunting the growth and often killing the plants. Centipedes are most active in the spring of the year; as the soil dries out they go deeper in the soil and damage stops. They are most active in low areas in fields and particularly in soils rich in organic matter. In asparagus lands summer and winter flooding is successfully practiced. Early planting is often of some help so that the plants are of some size before extensive injury begins. In certain soils D-D at 400 pounds per acre has given some control, although the use of the newer fumigants has not been too satisfactory. Carbon disulphide is effective, but too costly for general field application.

GARDEN CENTIPEDE



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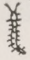

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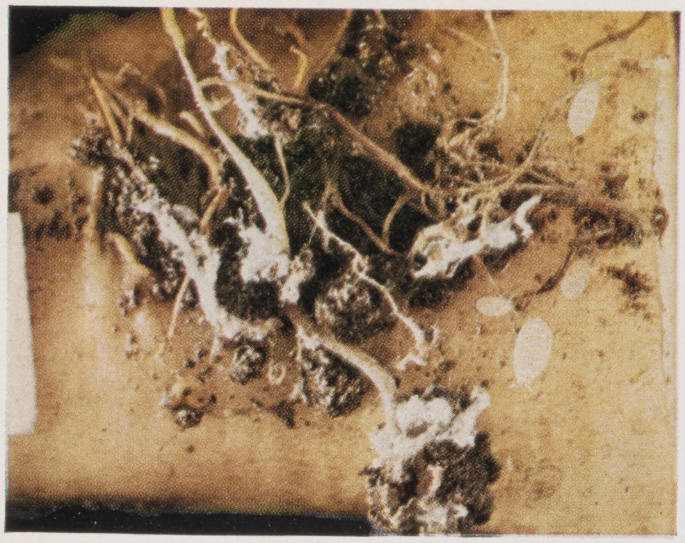
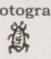
SUGAR BEET ROOT APHID



Photograph Enlarged x 2

 = Actual size

A white, moldy mass on the roots of sugar beets often indicates the presence of the **sugar beet root aphid,** *Prociphilus betae* (Doane). The outer leaves droop, turn yellow, and in severe cases the plants may die. During the middle of the day the plants often wilt. The yellowish-white, wingless, asexual forms (shown on the right of the photograph) may occur on beets at any time of the year or on old beets left in the fields. Several times during the year, winged migrants appear which spread the infestation. In California parthenogenetic reproduction occurs throughout the year. Wingless forms occur during most of the year on docks or other weeds, and on lettuce. In the Intermountain states winged females in the fall fly to cottonwoods and give rise to a sexual generation. Wingless females hatching from eggs in the spring form galls and produce winged forms which migrate back to beets or other hosts. Control consists in keeping the beets supplied with adequate water during their actively growing period. Once severe damage to the rootlets occurs, additional water will often kill the beets. Good sanitation, plowing dry in the fall, and crop rotation all assist in controlling this insect.

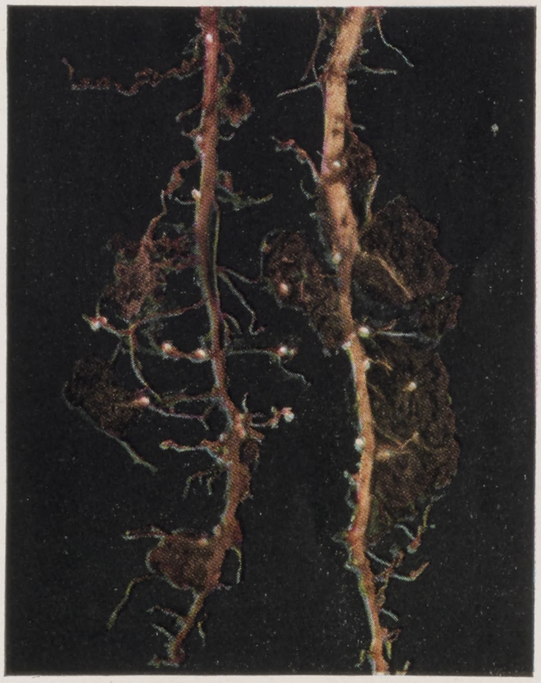
NEMATODES

The **sugar beet nematode,** *Heterodera schachtii* Schmidt, and the root knot, or garden nematode, *Heterodera marioni* (Cornu) Goodey, are the two nematodes occurring on beets in California that are known to substantially reduce sugar beet production. They are discussed separately as their distinguishing characteristics and control are somewhat different.

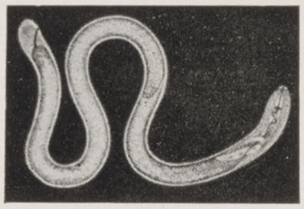
The **sugar beet nematode** occurs in many of the beet growing areas of California. Affected beets show poor growth and in certain spots may fail to grow entirely. The plants often wilt in the middle of the day even when irrigated. The foliage usually has a yellow appearance. Plants often exhibit a hairy root condition and small, white, lemon-shaped cysts, smaller than the head of a pin, are found clinging to the roots (as shown in the photograph). These cysts are the bodies of dead females, each of which contain from 100 to 300 eggs. These thick-walled cysts protect the eggs and make it extremely difficult to kill them by chemicals or cultural treatment. The larvae when hatching are 1/60 inch long, and crawl through the soil until they reach a beet root, then enter and begin feeding. The larvae swell, burst the host tissues and form the characteristic lemon-shaped bodies. The eggs in the cysts can hatch over a period of years. Host plants include beets, cauliflower, cabbage, turnip, rape, radish, rutabaga and mustard. These susceptible crops should not be grown in any rotation designed to reduce populations of the sugar beet nematode. Weeds such as mustards should be eradicated from infested fields as they lessen the effect of any rotation scheme controlling nematodes. Crop rotation is the best control as it attempts to "starve out" this nematode. This method does not eradicate it, but makes it possible to obtain a crop of beets one year in four years. Crops that are not attacked and which serve satisfactorily in ro-

(Continued on page 8)

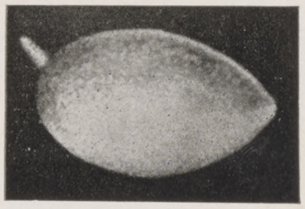
SUGAR BEET NEMATODE



Photograph Enlarged x 2



Male nematode enlarged x 80

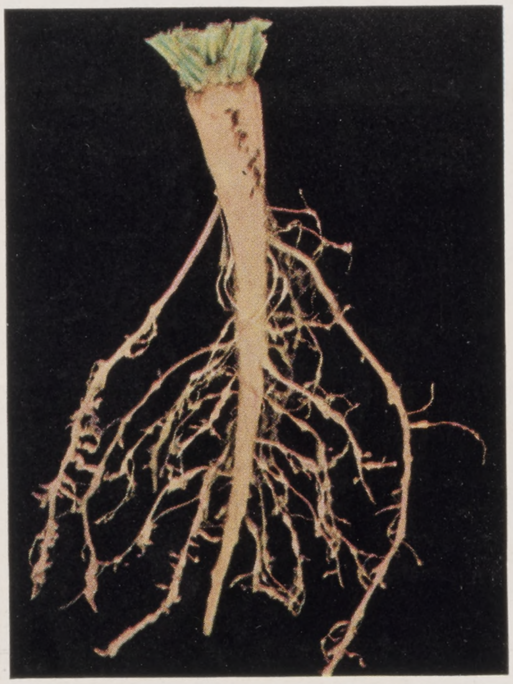


Female nematode enlarged x 50

NEMATODES *(Continued)*

tations include wheat, barley, oats, peas, potatoes, corn, tomatoes, onions, beans and alfalfa. Early planting is desirable in infested soil as beets not attacked in the seedling stage will often make satisfactory growth. D-D at 250 to 400 pounds to the acre has been found to give increased yields of beets when used before a crop is planted. Further research is necessary, however, to determine the economic efficacy of soil fumigation. To date no fumigants can be applied to eradicate nematodes but are used merely to obtain stands in fields where otherwise decreased yields or no yield would be obtained.

ROOT KNOT OR GARDEN NEMATODE



The **root knot,** or **garden nematode,** is serious in certain parts of California. The nematodes cause characteristic galls, or knots on the roots; in fact, in certain cases the entire root system may have a knotty, swollen appearance. The nematodes, unlike those of the sugar beet nematode, cannot be seen from the outside as they are entirely within the tissues of the root gall. Beets show galls, wilt during the middle of the day, show reduced growth, and may be killed entirely in the seedling stage. Damage is usually spotted in the field and usually lighter soils show heavier infestations. The larvae are present in the soil during the entire year, becoming active around 50° F. In the spring the larvae enter roots and the feeding causes the characteristic root enlargements. Eggs are deposited in a gelatinous mass, and may be inside or outside the root. Each female lays 400 eggs or more and a new generation is started. In California the time of development from larvae to mature females is 25 to 30 days, with five or more generations a year. Some 1,200 plants are affected by the root knot nematode. Plants often injured include sugar beets, cucumbers, melons, carrots, lettuce, cotton, grapes and others. Some crops are usually resistant, such as rye, barley, wheat, corn, broccoli, cauliflower, garlic, onion, alfalfa, and cowpea. Although a particular crop may not show injury, nematodes may be able to increase enough to cause damage to a subsequent susceptible crop.

Crop rotation is not as successful as is the case of the sugar beet nematode but it is well not to grow successive crops of susceptible plants. Summer fallowing is often of value. Soil from other fields should not be hauled in or any wash water or soil from beet dumps used. In certain cases it may help to clean equipment when going from infested to non-infested fields. It often pays to plant early before the nematodes are active. The new soil fumigants D-D and EDB are being used successfully in partially controlling the root knot nematode. D-D is used at 200 pounds per acre and EDB at 20 gallons of 10 per cent material per acre. Further research should give more information concerning the efficacy of soil treatment for the control of this nematode.

SUGAR BEET INSECTS *(Continued from page 1)*

often are of considerable value to the grower in ascertaining the possibility of damage by pests present at the time of planting. With this information the grower is able to rotate to the disadvantage of certain pests, plant early so that the beets are well established before severe injury occurs, treat with a soil fumigant or use other methods of averting damage. Outbreaks due to migrating pests are difficult to predict and it is here that the infestations must be detected early and appropriate control measures taken before severe damage is done.

Many insects causing damage to sugar beets hibernate under debris or in weeds or on the roots of weeds in the environs of sugar beet plantings. The necessity for good sanitation and weed control cannot be over emphasized.

It should be mentioned that of the some one hundred and fifty insects which have been reported feeding on sugar beets in the United States, only forty have caused economic damage, and in California there are less than a dozen species which cause serious injury to large acreages of beets. Occasionally individual fields may sustain severe losses from certain insects but the total percentage lost for the state is small. Since 1930 losses sustained by curly top, a virus disease transmitted by the beet leafhopper, have been reduced to a minimum due to the development of resistant varieties by the combined efforts of the sugar companies and the U. S. Department of Agriculture, and in destroying the leafhopper in its breeding areas in the San Joaquin Valley of California. Continued vigilance is necessary, however, in order to avoid losses in the future.

Insect populations and associated outbreaks are difficult to predict. One reason for this is the occurrence of many beneficial insects on sugar beets, both predacious and parasitic, which often are able to materially reduce the populations of threatening pests. In addition, the occurrence of certain insect diseases may occasionally kill such a high percentage of certain larvae, such as armyworms, that a major problem is averted. Populations of the sugar beet root aphid are closely associated with predacious enemies and a fungus disease. Entire colonies may be killed through the efforts of the larvae of a small predacious fly *(Thaumatomyia glabra)* and a syrphid fly *(Metasyrphus wiedemanni)*. Under high moisture conditions a fungus disease often kills entire colonies. This example illustrates the necessity for those associated with sugar beet production to recognize the beneficial insects found on sugar beets as well as those causing damage.

Spreckels Sugar Beet Bulletin

Vol. XI March-April No. 2 [pages 9-16]

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SPRECKELS SUGAR BEET BULLETIN

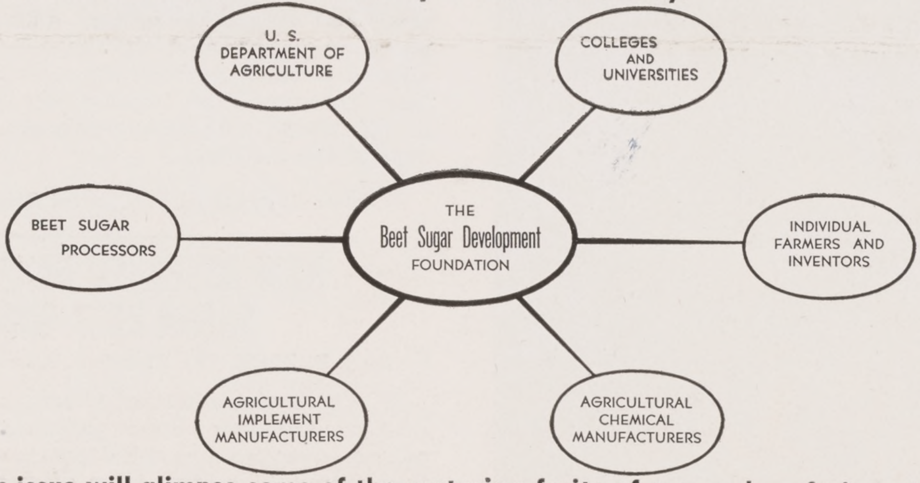
PUBLISHED FOR CALIFORNIA SUGAR BEET GROWERS BY THE SPRECKELS SUGAR COMPANY

Vol. XI MAY-JUNE 1947 No. 3

1

RESEARCH—THE BEET GROWER'S PARTNER

Agricultural research on behalf of beet growers draws upon all sources relating to sugar beets. Sketched below is the organization chart of the beet industry's research activity.


U. S. DEPARTMENT OF AGRICULTURE
COLLEGES AND UNIVERSITIES
BEET SUGAR PROCESSORS
THE Beet Sugar Development FOUNDATION
INDIVIDUAL FARMERS AND INVENTORS
AGRICULTURAL IMPLEMENT MANUFACTURERS
AGRICULTURAL CHEMICAL MANUFACTURERS

Readers of this issue will glimpse some of the maturing fruits of research — fruits which will ripen and become important aids to higher beet yields at reduced costs.

THE PETROLEUM INDUSTRY CONTRIBUTES TO SUGAR BEET RESEARCH

By DR. ROY HANSBERRY, *Director*
Shell Agricultural Laboratory

Farmers of California and the nation, and more particularly the sugar beet industry, gained a new scientific partner recently when the Shell Oil Company, Incorporated, placed in operation a new half-million dollar laboratory and experimental farm seven miles northwest of Modesto in Stanislaus County. The Modesto site was chosen after intensive study of conditions and facilities in all sections of the United States, because of the wide diversification of crops which are successfully grown there and because it is an exceptionally rich agricultural area.

2

Dr. Roy Hansberry

A scientific staff of thirty scientists, headed by Dr. Roy Hansberry, is employed in the fields of entomology, plant pathology, plant physiology, nematology, horticulture, and agricultural engineering. The major aim of the laboratory is to develop agricultural uses for petroleum chemicals.

Sugar beet growers are already familiar with Shell's nitrogation and nitrojection processes for the application of ammonia, and, in the Intermountain states where the sugar beet nematode has been a serious problem, the use of Shell D-D* soil fumigation for the control of this pest has given greatly increased yields. The sugar beet nematode is a serious problem in some areas in California and in others the rootknot nematode is a limiting factor. Here, too, the practice of soil fumigation with D-D has been of great value to the sugar beet industry.

(Continued on page 19)

3

The Shell Experimental Farm—central laboratory and a portion of the fields and orchards.

The Modesto laboratory is working to improve and expand the uses of D-D and ammonia, as well as on many other new lines of research. DDT vapor sprays, now in the development stage, have been widely tested and show great promise in the control of the sugar beet leafhopper, both in the foothill breeding areas and in the sugar beet fields themselves. Both ground and airplane applications of Shell Vapona 1D have been used successfully in the control of this pest.

Recent developments from Shell's agricultural laboratory include two new weed killers: Shell Weedkiller No. 10 and Shell Weedkiller No. 20. These are petroleum oils especially selected for their high aromatic content and toxicity to weeds. Shell Weedkiller No. 10 is used largely in the place of stove oil for weeding carrots, although blends of No. 10 with kerosene have been used in the control of wild oats in flax. Shell Weedkiller No. 20 is an all-purpose product intended primarily for use along roadsides, ditchbanks, or in orchards. The possibility of using No. 20 in sugar beet weeding is being explored cooperatively by Mr. William E. Ijams, field superintendent, Spreckels Sugar Company, and by Mr. Frank B. Herbert, horticulturist of the Shell Agricultural Laboratory. The results of these tests are looked forward to with eagerness by both organizations.

The agricultural laboratory is a new organization staffed by young men with ideas and vision. They have every confidence that they will be able to add many new materials to Shell's present line of agricultural aids, which include such diverse products as petroleum oils for insect control, light oil solutions of insecticides for use in household, livestock and agricultural pest control, several distillates and fractions used in killing weeds, anhydrous ammonia for fertilizer, and D-D for soil fumigation. Shell's scientific staff is working closely with university, federal, state, and county agricultural authorities. It will be of great interest to watch the developments in agricultural chemicals which are bound to come from the new laboratory. The sugar beet industry, like many other branches of agriculture, will undoubtedly gain much from the results of this research.

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*Trademark registered U. S. Patent Office.

HOW RESEARCH BENEFITS THE SUGAR BEET GROWER

By J. E. COKE, *Vice President, Spreckels Sugar Company*

The collective effort of Government and private industry in the United States and Canada to increase yields of beet sugar per acre and decrease costs of production is tremendous. The large force of men employed by beet sugar companies and by state and federal experiment stations is continuing its many years of effort to create improvements in the beet industry.

To coordinate the activities of the United States and Canadian beet sugar companies in their search for improved sugar beet production practices, the industry, two years ago, formed The Beet Sugar Development Foundation.

The Foundation not only attempts to keep sugar companies currently informed on the progress of all research work, which may have a bearing on sugar beet production, but it contributes financially to government and private research organizations in conducting projects specified by the Foundation. It also coordinates many research projects being carried on by the beet sugar companies so that the maximum results can be obtained within the minimum time.

At the present time, the Foundation is financing part, or all, of the costs of specified research projects at ten state experiment stations from Michigan to California. In addition, all the major beet sugar companies, including the Spreckels Sugar Company, are conducting research in beet production in cooperation with the Foundation. The work involves such projects as further development of mechanical harvesting, row spacing tests, improvement of seed processing methods, basic information on the placement and utilization of fertilizers, beet by-product utilization, mechanical thinning methods, improvement in beet drill design, improvement in seedling emergence, and weed control in beet fields.

The headquarters of this organization is at Fort Collins, Colorado, but inasmuch as the activities of the organization are directed by representatives from beet sugar companies throughout the United States, the problems which the Foundation attempts to solve are nationwide and apply to California and Michigan as well as the Intermountain and Midwestern areas.

To integrate the individual research activities of the agencies involved in improved beet production, there exists the American Society of Sugar Beet Technologists. Biannually, some 300 members gather for three to four days at a joint meeting to review and discuss these problems. It is a valuable clearing house for sugar beet production information.

Few, indeed, are the agricultural industries having as extensive and coordinated a program for improvement as does the sugar beet industry.

Photographs of a few of the Foundation-sponsored projects appear on pages 20, 21, and 22.

1947 BEET CROP: According to Government sources, the acreage to be harvested in California during 1947 is 162,000, or 32 per cent greater than the 123,000 acres harvested in 1946. It is estimated that the increase for the nation will amount to about 10 per cent.

The beet crop generally in California is farther advanced than the crop has been at this date for several years and the prospects are that better than average yields will be realized this year.

Of considerable concern to growers in some districts is the subnormal rainfall, although in most areas it is expected that there will be adequate water to carry the beet crop through to maturity.

While population of the beet leaf hopper has been greater this year than for the past several years in the southern Salinas and San Joaquin valleys, it is expected that the yield will not be affected greatly because of the wide use of varieties resistant to the Curly Top virus, and the prompt and general use of control measures in the beet fields.

THE DEVELOPMENT OF PRECISION PLANTING EQUIPMENT

By PROF. ROY BAINER, *University of California*

4

Prof. Roy Bainer

The introduction of processed sugar beet seed in 1942 and its subsequent widespread adoption created a demand from growers for improved planting equipment. Studies were initiated at the University of California, a few years ago, in an endeavor to improve the distributing characteristics of various types of planting equipment.

Preliminary to starting the planter testing and development program, laboratory apparatus was set up for testing the units before making field trips with them. The apparatus (see photograph) consisted of a stand adjustable in height, for mounting the units under test. A suitable power drive was provided for operating the unit at speeds comparable with those encountered in the field. An endless conveyor was provided for carrying grease-coated boards under the planting device being tested, to receive and hold the seeds metered by the unit for distribution studies. The speed of the conveyor can be varied to correspond with planting seeds in the field.

A method for making a statistical analysis of the data covering the seed arrangement on the grease boards was developed by Brooks and Baker. The dispersion coefficients obtained from an analysis of the data provided a mathematical comparison of the different planters for similar seeding rates.

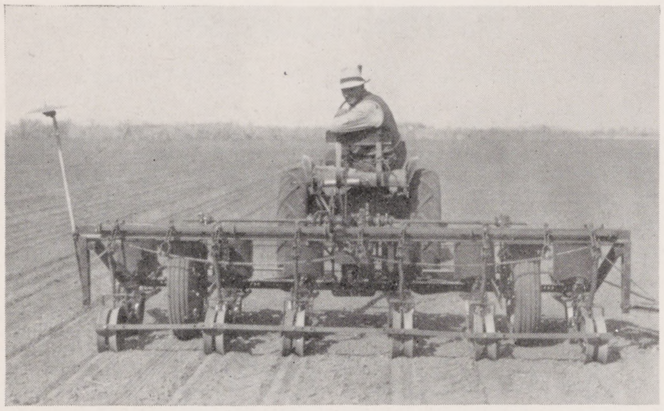
Early in the planter development program, uniform close grading of processed seed was found necessary if multiple-cell fill was to be avoided. Seed processed by segmentation gave best results when graded to within a range of 2/64 inch in size. Seed processed by decortication or burr reduction may vary as much as 3/64 inch in size without causing double cell fill. Likewise, graded whole seed and pelleted seed gave little trouble with multiple cell fill when sized within a 3/64 inch limit.

Planters employing either vertical, horizontal, or inclined plates, are capable of uniform metering of seed. It is essential that the cells in the plate fit the seed to be planted. The diameter of the cell should be 1/64 inch larger than the maximum diameter of the seed to insure proper clearance. Movement of seed through the cell is further improved by tapering (approximately 12° inclined angle) the cell wall from top to bottom. Proper plate thickness depends upon the type of seed. Processed seed graded through a 10/64 and over a 7/64 requires a plate thickness of 8/64 inch (0.125″). A plate thickness of 0.140″ to 0.150″ is required for whole seed graded 11/64 to 8/64 inch size.

The manner in which seeds leave the plate and are conveyed to the furrow has a considerable influence upon

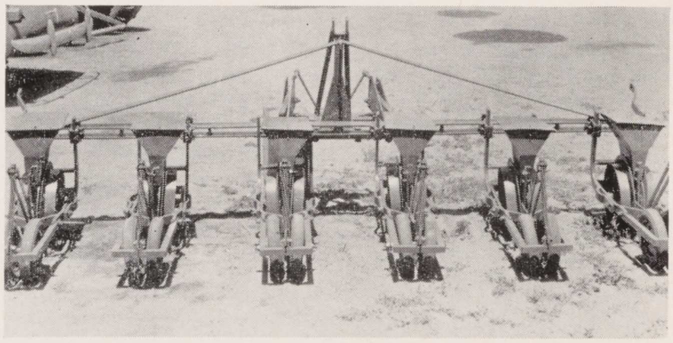
(Continued on page 23)

PLANTER DEVELOPMENTS



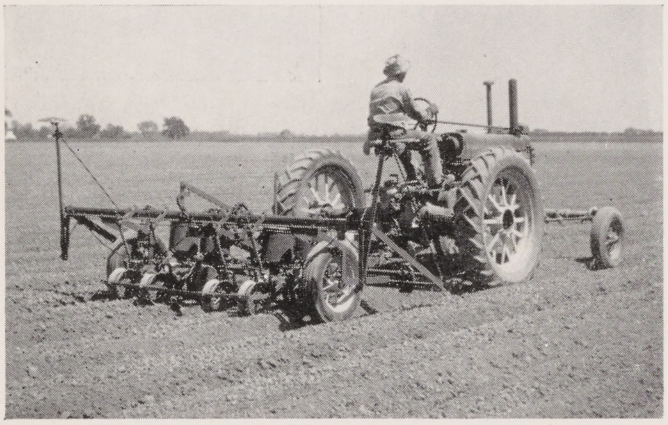
5

The John Deere No. 66 planter is a commercial application of the smooth-tube, low-drop principle of precision planting.



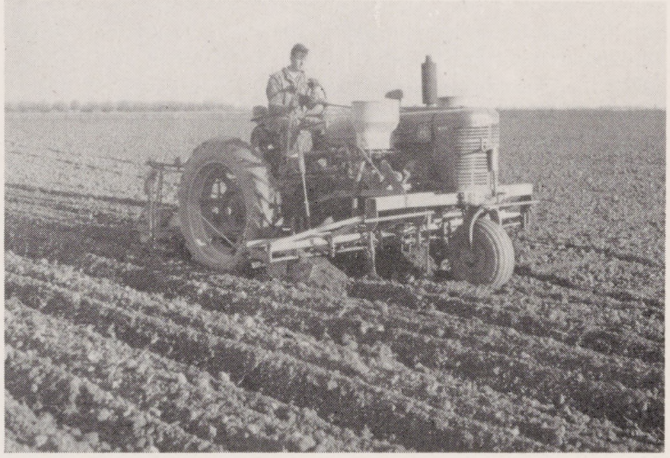
6

These Paul Milton planter units are mounted on the quick-detachable tool bar of a Ford-Ferguson tractor.



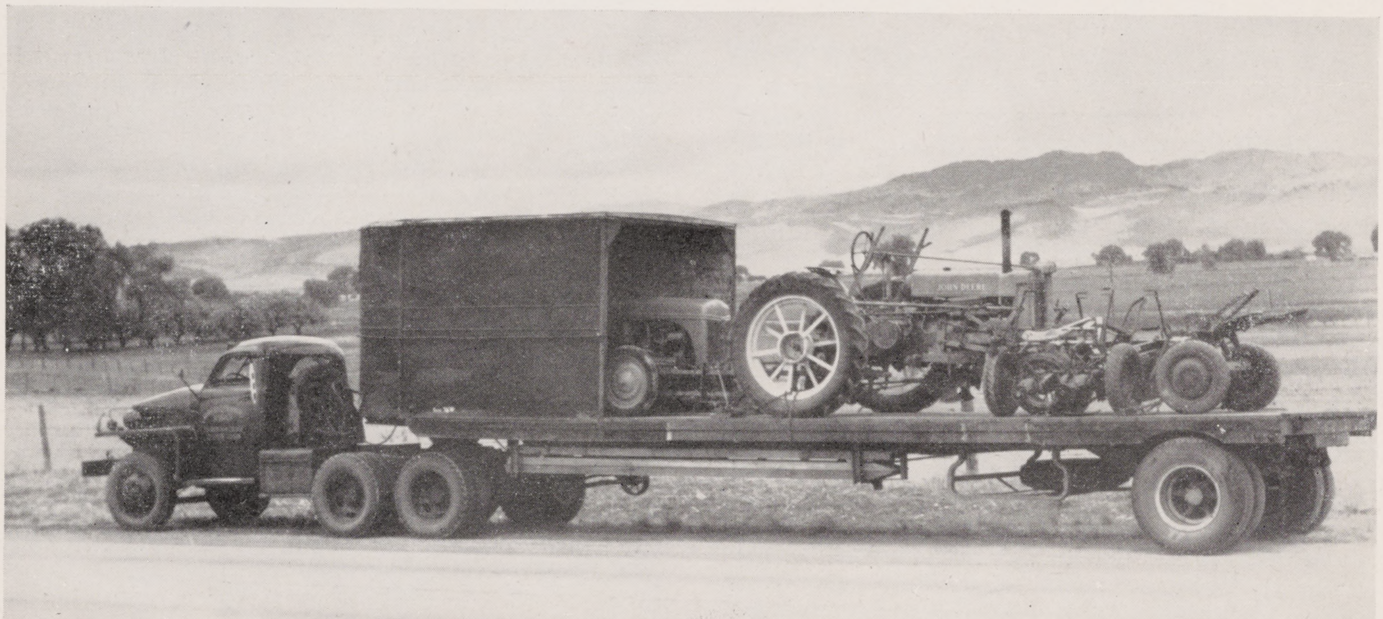
7

For California users, the John Deere No. 66 planter may be quickly adjusted to plant four rows on beds.



8

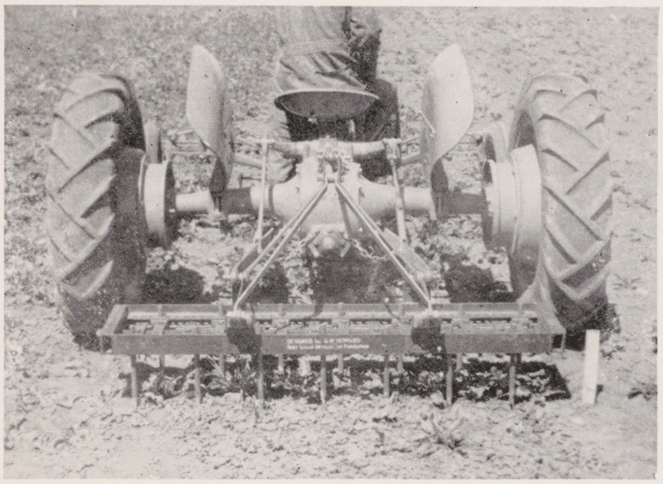
E. H. Jaeger of Woodland, California, constructed this ingenious combination of lister, bed former, harrow and planter. Once over the field, and all four operations are completed.



9

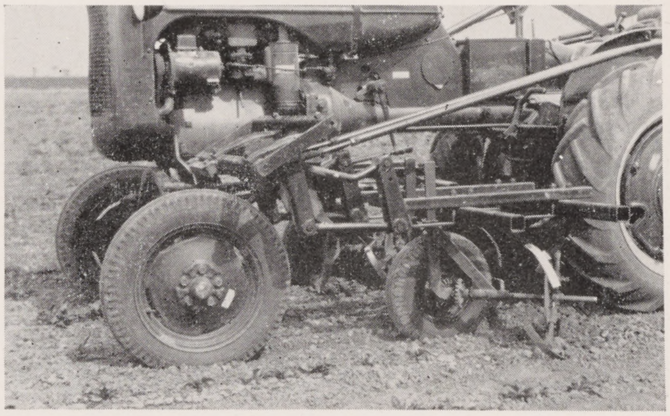
The Colorado A. & M. College expedites its planting and thinning experiments with this well-equipped truck.

BLOCKER DEVELOPMENTS



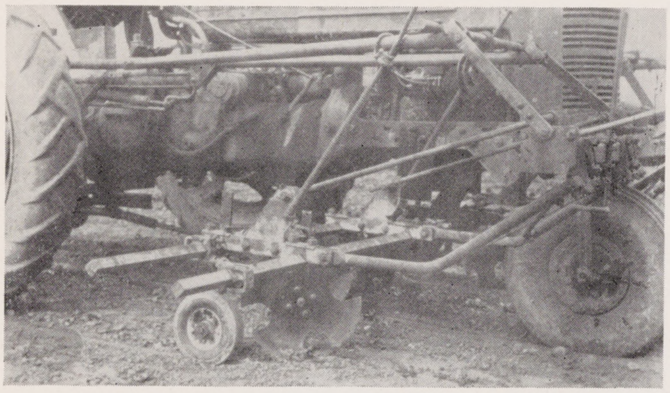
10

Developed by the Beet Sugar Development Foundation, this cross blocker has block-spacing adjustments operable by the tractor driver while in motion.



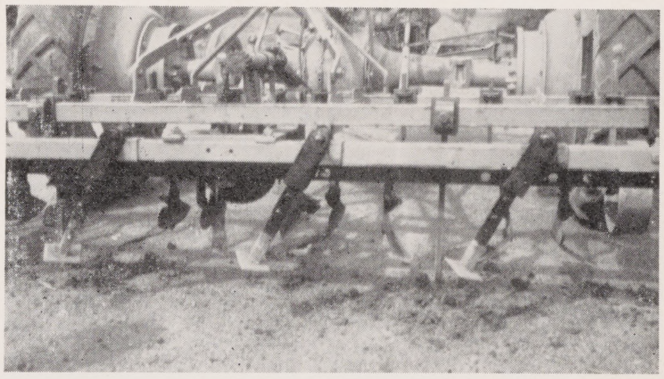
11

The Paul Milton blocker is built in two-row units for tool bar mounting. Adjustable for row spacing, block width and block centers.



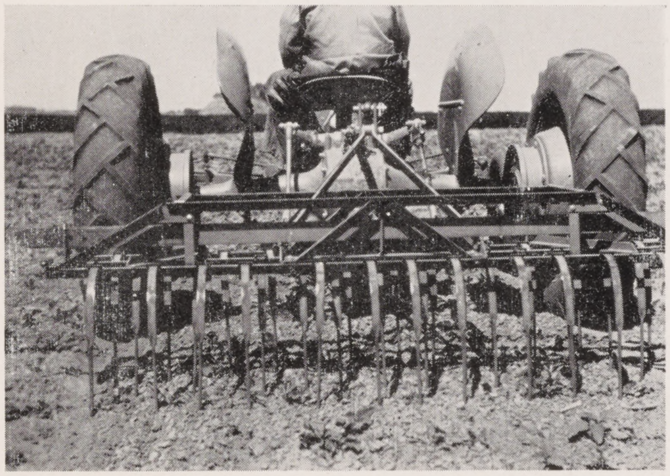
12

The Eversman blocker is an example of the rotary type, tractor mounted unit.



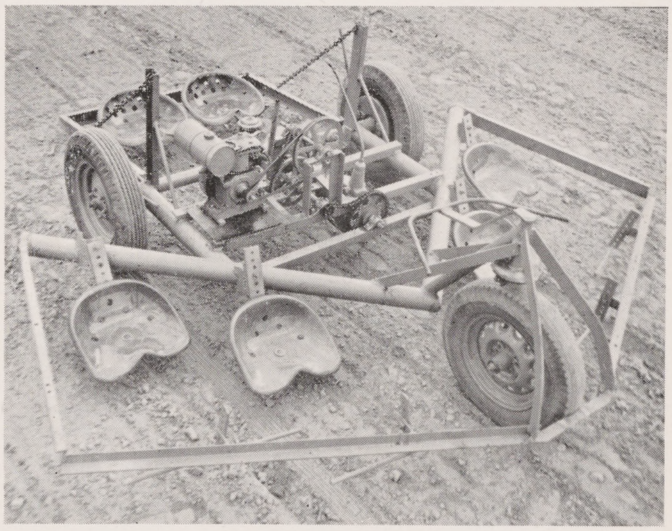
13

The Glenn Ferguson beet blocker uses diamond knives which sweep back and forth across six rows of beet seedlings.



14

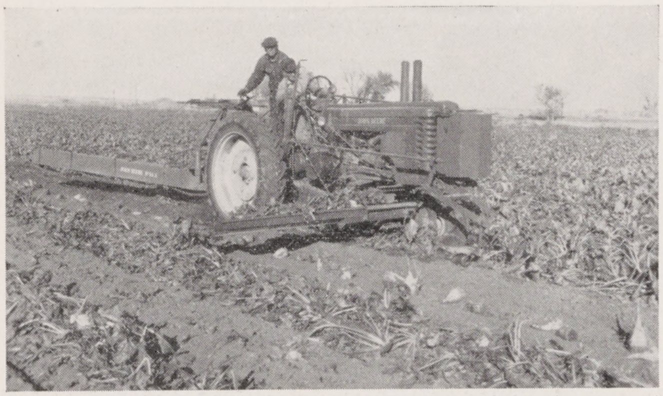
The "Pencil Spring" bean weeder acts both as a weeder and cross blocker.



15

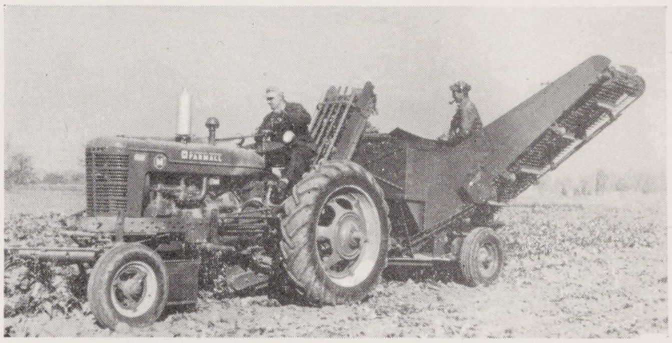
This self-propelled worker-carrier is popular in Utah, Idaho and Oregon. Six hand thinners ride in comfort while they hoe-thin the beets.

HARVESTER DEVELOPMENTS OUTSIDE OF CALIFORNIA



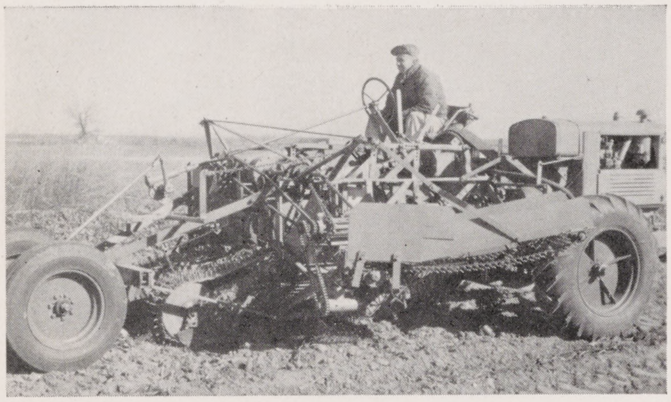
1

The John Deere beet harvester deposits alternate windrows of beets and tops. A companion machine loads the beet windrows into trucks.



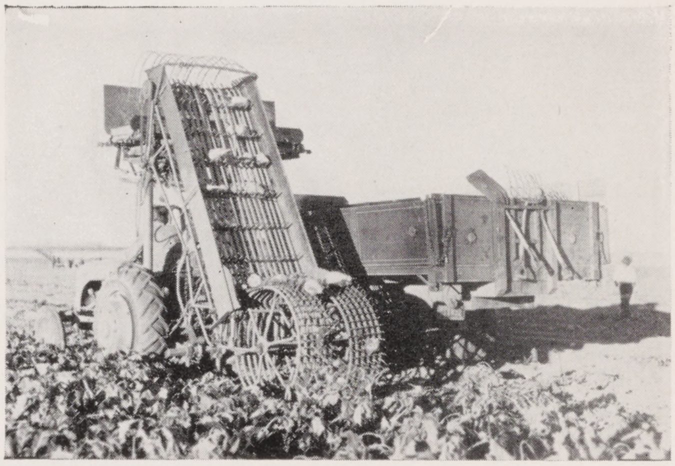
17

The McCormick-Deering sugar beet harvester solves the clod problem by delivering ground-topped beets to a sorting belt, where an operator removes the beets from the clods and drops them into a trailer cart with unloading elevator.



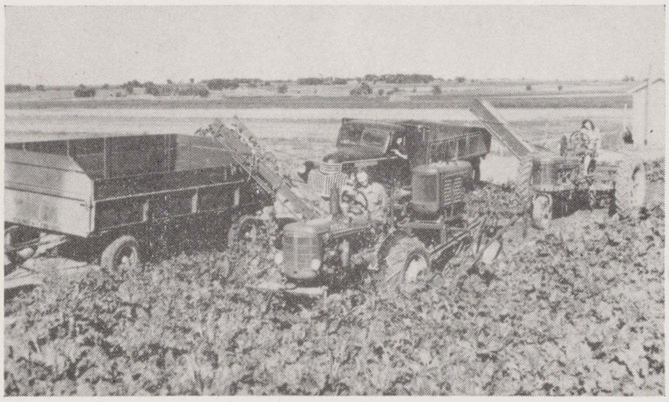
18

The Sichc beet harvester is an experimental self-propelled machine. Beets are ground-topped and windrowed for subsequent mechanical pickup.



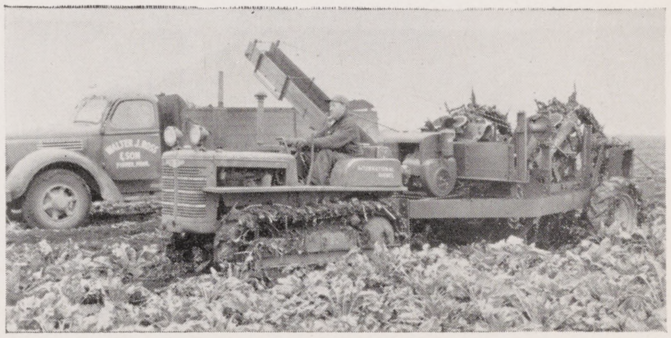
19

Harry Ferguson, Inc. is developing this beet harvester. Mounted on a Ferguson tractor, the pick-up wheels, elevator and cross chute serve for both tops and beets. The field is first topped, then the topping unit is removed and replaced by the lifting unit.



20

The Kiest harvester works in two units. The topper delivers tops from four rows to one truck, while the lifter delivers beets to a second truck. Suitable for friable soils.



21

Built in Minneapolis, the Harvall beet harvester picks up alternate rows of beets on spiked wheels, disk-tops them and delivers to the truck.

PRECISION PLANTING *(Continued from page 19)*

their distribution. A seeding rate of 4.5 pounds of segmented seed per acre at 2.5 m.p.h. requires the metering of 30 seeds per second. Therefore, a seed that is delayed only 1/30 second is overtaken by the seed from the next cell. Positive unloading of the cell is essential to regularity of drop. Seeds upon leaving the cell have a component of velocity equal to the speed of the cell. The trajectory followed by each is quite variable. This alone accounts for some of the irregularity experienced with the drop. Substitution of small smooth tubes (½″ in diameter) for the standard spiral ribbon tubes found on many planters confines the path of the trajectories to a width equal to the diameter of the tube. A smooth tube also offers less restriction to the seed as it falls to the furrow.

Several commercial planters are capable of precision metering of properly graded seed. However, the principal problem yet to be solved deals with proper placement of seed in the ground to insure maximum field germination. Precision planting requires precision seed and precision farming practices if the greatest gains are to be realized. Planters available today are capable of better performance than the seed and farming practices used justify. New developments in seed processing indicate the possibility of producing seed with a higher germination, a greater factor of safety and improved shape for use in a precision planting program. Weather hazards will continue to be one of the controlling factors in obtaining satisfactory stands, even though the best available planting equipment and seed is used. In areas where plantings can be irrigated to insure germination, part of the hazards are removed.

The insuring of high field germination and a weed-free seed bed are therefore the chief goals of research on the subject of planting.

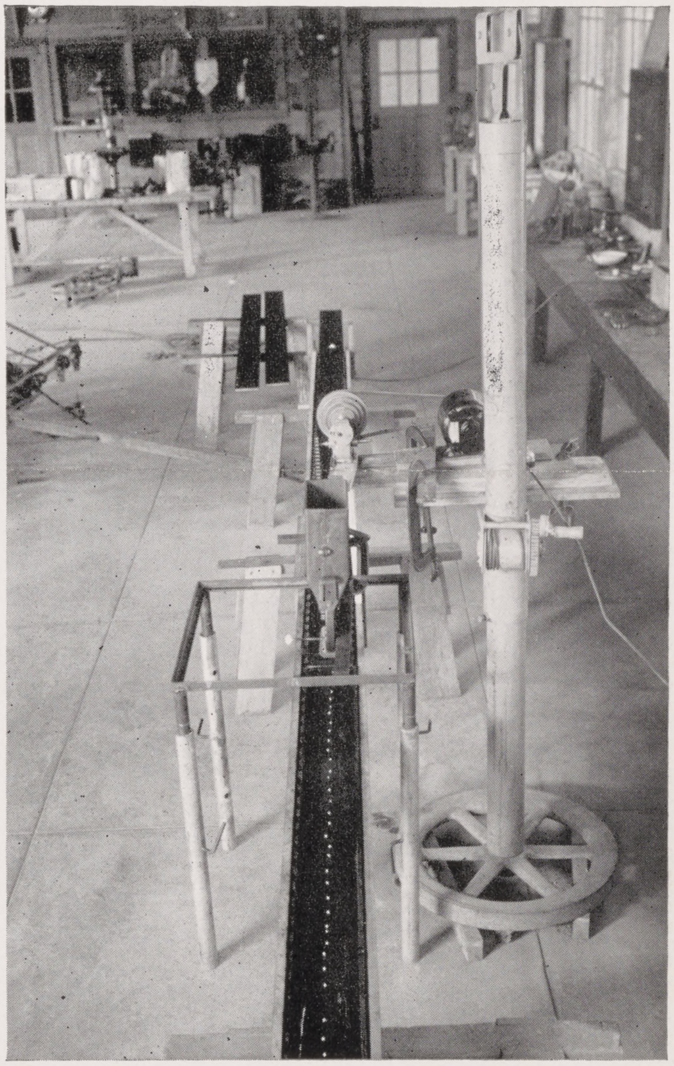
IMPROVING SUGAR BEET SEED VARIETIES

By R. S. LAMBDIN, *Assistant District Manager, and*
W. B. MARCUM, *in charge of Plant Improvement Project, Spreckels Sugar Company*

The plant breeding program of the Spreckels Sugar Company was inaugurated in January of 1945 for the purpose of increasing sugar production through varietal improvement of sugar beets. The basis of the program at that time was to develop seed strains through selection and hybridization which contained the following specific characteristics:

1. Resistance to the factors causing bolting.
2. Resistance to the organisms causing Downy-Mildew.
3. Resistance to the virus causing Curly-Top.
4. Maintenance of or increased yields of roots and percent sucrose.
5. Recombination of the above characters.

The investigational work carried on during the 1945 season led to the development of a wide number of strains and furnished the basic material necessary to establish resistant varieties. These strains were tested in 1946 under conditions favorable for high bolting and heavy mildew infection, and further selection was made for resistance. In addition, a considerable amount of hybridization work was done with highly resistant selections previously made, with the result that the Company now has developed approximately 1,500 seed strains and has made over 5,000 root selections from a wide number of lines, many of which show considerable promise for future use in producing sugar.



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This apparatus was built by the Agricultural Engineering Division of the University of California for testing various planters by the grease-board method.

In the fall of 1946, the Spreckels Sugar Company established a Plant Breeding Farm to provide more adequate facilities for the continuance of its plant breeding program. The farm consists of 100 acres and is fully equipped to conduct all the necessary farming operations for both breeding work and the general crop production desired for proper rotation. Some 937 seed strains are being tested in 1947 principally for bolting and Downy-Mildew resistance, and it is hoped that selections from the most promising strains will furnish a superior variety suitable for earlier planting and having disease resistance.

Several strains now in the process of development in isolated areas show considerable merit in being highly

(Continued on page 24)

SEED VARIETIES

(Continued from page 23)

resistant to bolting, Downy-Mildew and Curly-Top. The seed from these strains will be utilized to make planting tests to determine their adaptability under a wide range of conditions in the beet growing areas in which the Spreckels Sugar Company operates. If they meet the stringent requirements necessary, a portion of the seed will be utilized for increase, and as soon as a sufficient supply of seed is available it will be released to the growers for sugar production.

All varieties that look promising in breeding programs are tested in variety tests. These tests furnish the information for deciding which varieties are the most adaptable to the areas in which the Spreckels Sugar Company operates. Any varieties selected for commercial production are turned over to the West Coast Beet Seed Company for the final reproduction.

The West Coast Beet Seed Company's stock is controlled entirely by sugar companies, the Spreckels Sugar Company being one of the largest stockholders in the group. The Seed Company produces commercial sugar beet seed in Oregon, Northern California and the Hemet Valley in Southern California. It is the function of the West Coast Beet Seed Company to contract sufficient beet seed acreage in the aforementioned areas to supply the requests of the participating sugar companies.

For several years the Spreckels Sugar Company, together with other California sugar companies, has been endeavoring to interest the United States Department of Agriculture in intensifying its program of developing sugar beet varieties more suitable to California conditions. Recently, preliminary approval was given for the establishing of a sugar beet breeding station in the Salinas Valley, and negotiations are now under way to obtain adequate facilities. In addition, the Spreckels Sugar Company has offered the facilities of its Plant Breeding Farm for such experimental work that the U.S.D.A. may desire to conduct, should such a station be established.

The Spreckels Sugar Company's primary interest in the seed program is to furnish growers the best seed as to variety and quality. It can do this only by its participation in programs which are continually searching for improvement of beet varieties.

SPRECKELS SUGAR COMPANY CONTRIBUTES TO SUGAR BEET RESEARCH

By GUY D. MANUEL, *Assistant District Manager and Chairman of Research Committee, Spreckels Sugar Company*

The present high state of development of the sugar beet industry can be credited very largely to findings of research. Since the ultimate is never reached in improvement, research today is as important and offers as much possibility for future improvement as at any time in the past.

The history of the Spreckels Sugar Company is one of close association with all forms of research directed toward the improvement of sugar beet production. In addition to its pro rata of contributions to joint industry research activities, the Spreckels Sugar Company has always and is continuing to conduct an aggressive independent program of research on behalf of sugar beet growers.

The Company is currently conducting investigations on various means of treating sugar beet seed with fungicides before issuing to growers; and fertilizer trials designed not only to determine fertilizing practices which will increase tonnage of beets, but which will increase sugar percent and yield of sugar per acre. Another project involves the improvement of sugar beet varieties, with the emphasis at this time on increased bolting resistance, resistance to the diseases causing mildew and Curly Top, and increased sugar percentage and seedling vigor.

The entire problem of obtaining improved emergence of seedlings, which is today one of the most critical problems in the industry, is receiving attention. This problem is being approached from such angles as application of soil loosening agents to the drill row, research in seed placement into moist soil, mechanically treating the drill row to prevent crusting, and methods of firming the moist soil around the seed to insure rapid germination.

Weed control both before and after planting to reduce the high costs of weed elimination in the field is being undertaken, as well as improved methods of removing dirt and trash from harvested beets.

The Company is also continuing its work of improving mechanical harvesters and methods of harvesting, and the preparation of beet seed for planting.

GROWERS HAVE STAKE IN RETAIL SALES

Those who keep a weather eye on the current outlook are beginning to see daylight in the sugar situation.

Grocerymen are receiving more sugar for sale. The controls on sugar sales have been loosened. There is a possibility of complete removal of marketing control of sugar within a year.

Growers of sugar beets have a big stake in this easing of the sugar marketing situation. Sugar beet growers are an integral part of the sugar business, a big part of it; and they have an important self-interest in the retail sales of sugar and its widespread use in home and factory. After all, it is made from the sugar beets they raise.

When they take from their grocer's shelf the familiar package of Spreckels Honey-Dew Sugar, they are buying for their own tables the finest sugar made. Spreckels Sugar is pure for every use. Long experience in sugar-making gives it the finest quality.

Growers who are proud of the sugar beets they raise are proud, too, of the fine final product: Spreckels Honey-Dew Sugar.

The SPRECKELS SUGAR BEET BULLETIN is published bi-monthly by the Agricultural Department of the Spreckels Sugar Company as a service to its growers.

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SPRECKELS SUGAR BEET BULLETIN

PUBLISHED FOR CALIFORNIA SUGAR BEET GROWERS BY THE SPRECKELS SUGAR COMPANY

Vol. XI JULY-AUGUST 1947 No. 4

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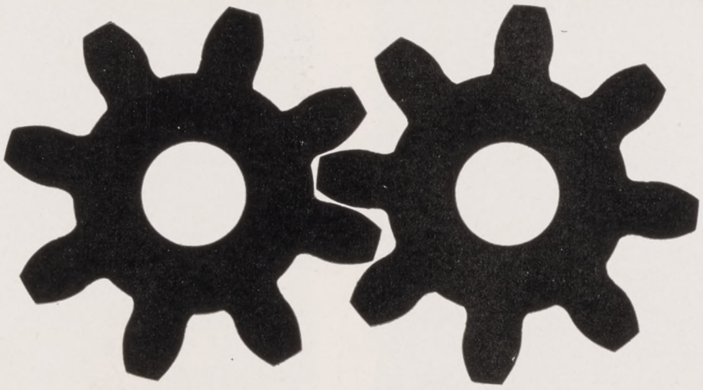
FIVE BILLION SPOONFULS OF SUGAR

will be made from beets harvested by Spreckels growers this fall. Company and grower operations alike will be geared into a closely meshed, integrated program.



The 1947 California beet harvest will soon be under way. As most growers will harvest their crop mechanically, a review and discussion of this subject are included in this Bulletin.

SPRECKELS SUGAR COMPANY'S PART IN THE 1947 HARVEST

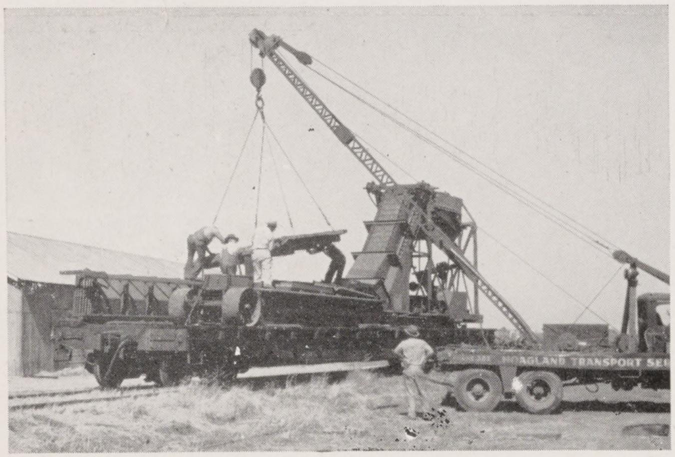
By J. E. COKE, *Vice President*
Spreckels Sugar Company

The 49th beet sugar campaign of the Spreckels Sugar Company will soon be under way. Construction and maintenance crews will complete construction and repair of beet receiving stations and processing machinery at the three factories by the middle of July. These three factories, with a combined daily slicing capacity of more than 9,000 tons of beets, will be ready to operate at maximum speed. Harvest is scheduled to be completed in November.

Adequate supplies of railroad cars and maintaining predetermined car distribution and train service to loading stations are necessary if the harvest is to proceed on schedule. To assure satisfactory rail service, plans of operation have been worked out with railroad personnel. The railroads believe that by the use of steel gondolas in the cooler coastal area and wooden gondolas, as well as beet racks, in the interior valleys, the car supply situation will be much better than in the previous several years. They also believe that improved railroad labor supply will result in satisfactory train service.

It is expected that labor conditions at loading stations will be more satisfactory. This will not only improve the service at the stations, but permit more nearly maximum loading of beet cars, thus aiding in the overall transportation situation. Improvements and thorough maintenance repairs in existing loading stations, as well as additional stations in several locations, should also contribute to a smoothly operated harvest program.

To complete the harvest on schedule it is necessary that factories operate daily to capacity throughout the entire season. The factory's operations are slowed down considerably below capacity if beets containing large quantities of trash are delivered to the factories and loading stations. It is, therefore, the responsibility of the grower to deliver clean beets throughout the harvest season. Beets held in storage for a few days during the periods of relatively high temperature that prevail prior to about the first of November become soft and difficult to process. Maximum factory capacity cannot be maintained and beet harvest cannot be completed on schedule if any quantity of soft beets is encountered during the campaign. It is, therefore, important that deliveries of beets prior to the first part of November, when piling is possible, are coordinated closely with slicing capacity. To do this, it will probably be necessary that rate of harvest be regulated during a part of the September and October harvest period. The Spreckels Sugar Company is anxious that this regulation will result in as little inconvenience as possible to growers and will attempt to work out such harvest schedules as may be necessary in cooperation with growers.



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Moving and erecting pilers to receive beets from Spreckels growers is one of the many Company activities which precede harvest.

Spreckels Sugar Company has provided a piling capacity in excess of 4,000 tons per day, in addition to actual factory capacity, which can be used after November 1, to assist growers in completing their harvest at a reasonable time.

To assist in providing an adequate supply of mechanical harvesters for 1947, the Company has added 25 new two-row Marbeet harvesters to the supply of harvesters it now owns. It has remodelled and repaired the harvesters purchased in previous years.

The policy of servicing and maintenance of the Company's harvesters during the 1947 campaign, by the use of service crews and fully equipped service trucks, will be continued.

To assist growers in maintaining more continuous and economical harvest operation, a supply of expendable harvest parts will be maintained by the Spreckels Sugar Company at the principal beet receiving stations for grower purchase.

With prospective good beet yields in all districts, and improvement in the general quality of labor for field, factory, and transportation, we are confident that the 1947 beet harvest and sugar production campaign will be carried to completion with dispatch and a minimum of difficulty.

ACCESSORIES FOR IMPROVING MARBEET HARVESTER OPERATION

By AUSTIN ARMER, *Agricultural Engineer*
Spreckels Sugar Company

The Spreckels Sugar Company has long recognized two shortcomings of the two-row Marbeet harvester—the lack of top recovery and the trash problem caused by the unfortunate location of coulters.

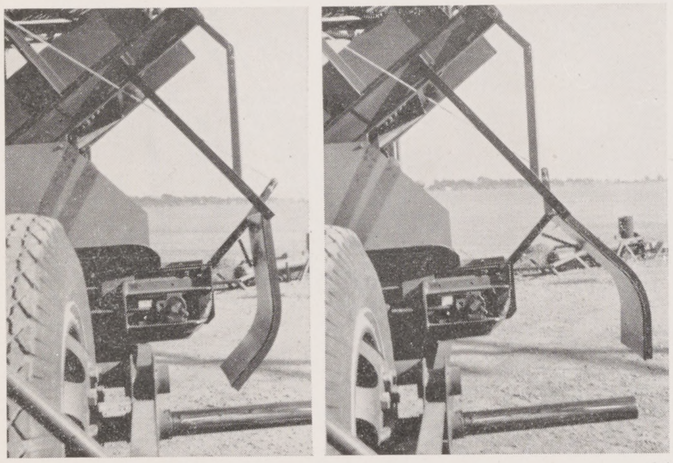
TOP RECOVERY

Several heroic attempts have been made to clean and deliver tops to trucks directly from the machine. These proved impractical, due partly to the complexity of the mechanisms and more specifically to the difficulty of synchronizing the simultaneous operation of two trucks in the field.

Considerable field experience led to the conclusion that the most practical system of top recovery is to deposit windrows containing the tops from four beet rows. These windrows are on about 80-inch centers, and are easily straddled by the trucks, consequently remaining undamaged.

Cattle pastured in fields of tops thus windrowed trample fewer tops and move around much less while feeding. Central feeding can be accomplished by picking up the tops, but this procedure is apt to be so expensive as to destroy much of the profit from feeding tops.

Working drawings of the windrowing device are reproduced on page 28. In operation, the top deflector is directed inward during the first round through the field. On the second round the deflector is directed outward, depositing tops adjacent to the first half of the windrow. This sequence is followed throughout the field, the machine operator changing the direction of the top deflector after each round.



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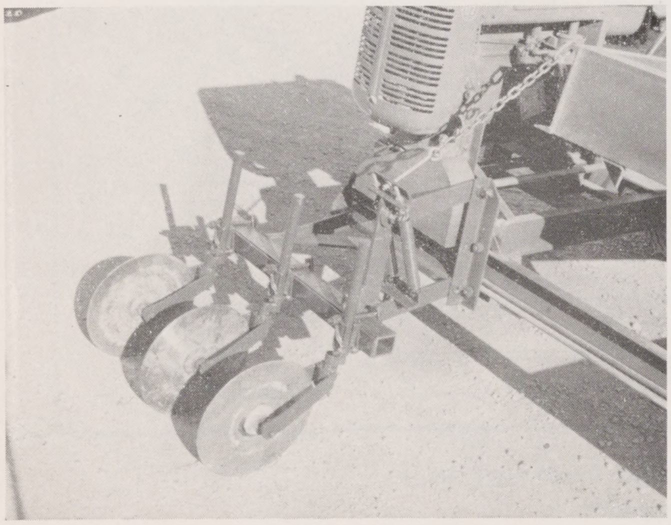
Top windrower for the two-row Marbeet harvester. *Left*—Deflector in. *Right*—Deflector out.

To permit the truck driver to concentrate on steering a straight course and accurately straddle the windrow, the beet elevator is made about 18 inches longer. (Most 1947 production Marbeet harvesters have the longer elevator.) To extend an elevator, it is necessary only to splice in two 18-inch lengths of six-inch channel just below the headshaft bearings, and to add 36 inches to the potato chain.

COULTER RELOCATION

The normal location of coulters under the subframe presents several problems. The coulters are inaccessible for greasing and depth adjustments. They gather trash which falls from the stripper blades, and often push large accumulations of trash ahead and under the harvester tongue. In light soils this accumulation becomes so severe as to uproot beets and require frequent stops and back-ups to clear out the accumulated beets and trash.



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Rear coulter mounting for the two-row Marbeet harvester.

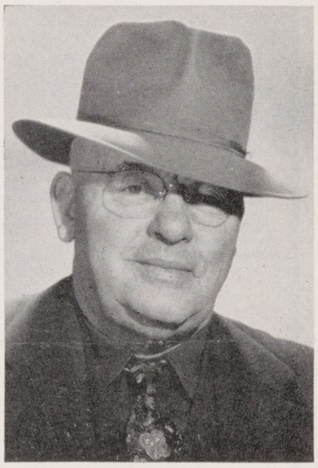
A cure for these troubles was effected by locating the coulters on a spring-depressed tool bar, mounted at the left rear corner of the main frame, so located as to run the coulters beside the two rows next to the ones being harvested. Thus, on all rounds after the first, the harvester operates on rows between which the trash has been cleanly slit by the coulters.

The operation is entirely automatic. The coulters are lifted by a chain fastened to the upper left rear corner of the subframe, and when the latter is dropped at the beginning of a round, the coulters fall into position and are held down by springs. This spring linkage on the coulters has two important advantages: The downward pressure remains constant regardless of ground irregularities, and the coulters cannot be damaged by hitting obstructions or being sunk too deep into hard ground.

Working drawings for the improved coulter mount appear on page 29.

INTERNATIONAL HM-1 BEET HARVESTER OPERATION IN 1946

By ERNEST A. HULL, *Sales Manager*
The Ray D. Henderson Company



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Ernest A. Hull

Since 1938 the University of California at Davis has been working on equipment for the mechanical harvesting of sugar beets.

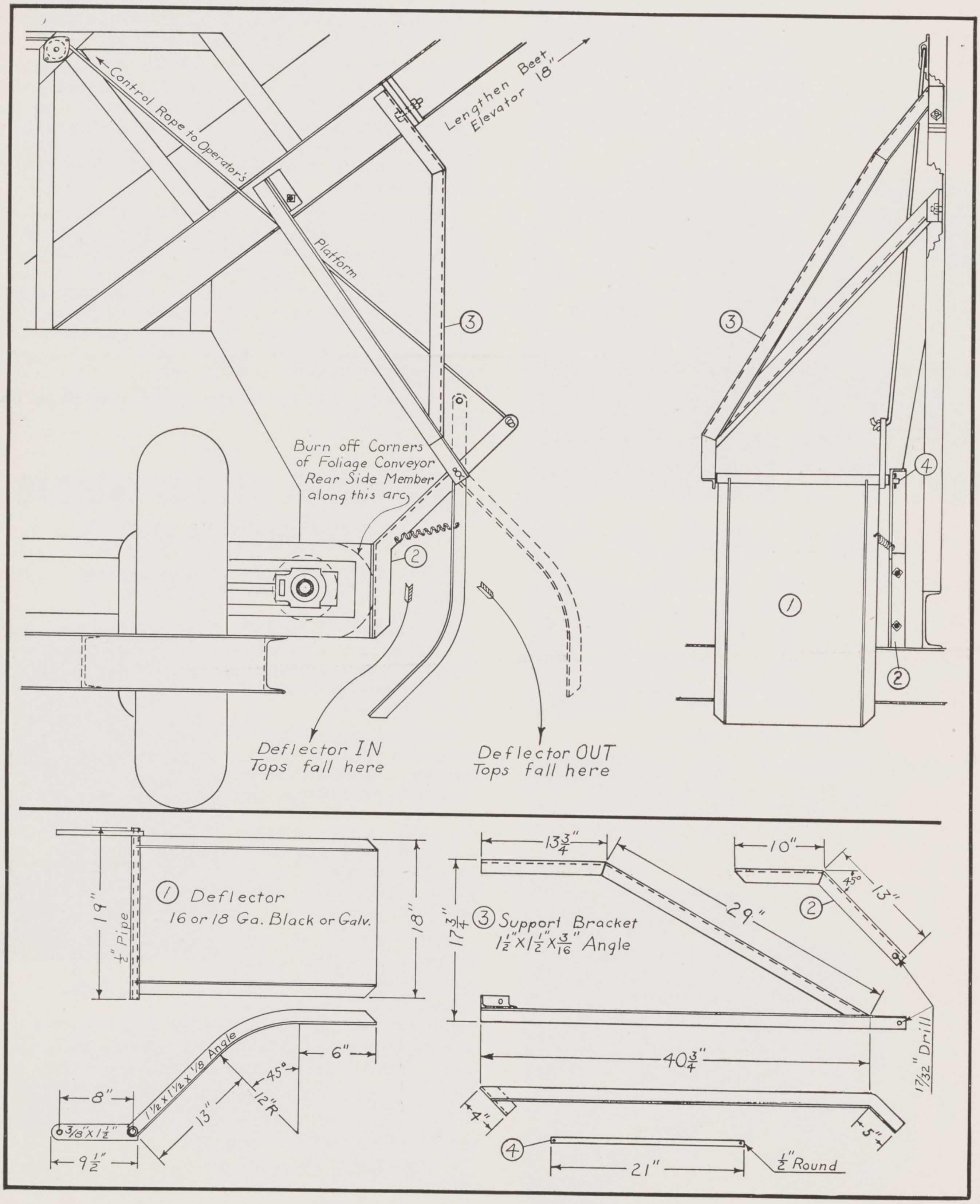
During this period they developed a very satisfactory beet topper and beet handling system. In conjunction with the engineers of the International Harvester Company, this topper was adapted to the attachment for use on the Farmall H and the Farmall M tractors in 1944.

Under the supervision of Professor Roy Bainer and representatives of the engineering staff of the International Harvester Company, the first beet harvester was used experimentally to harvest beets during the harvest season of 1944, harvesting approximately five acres.

In 1945, after further development, another test run was made harvesting 625 tons of beets in the Holland Land section near Clarksburg.

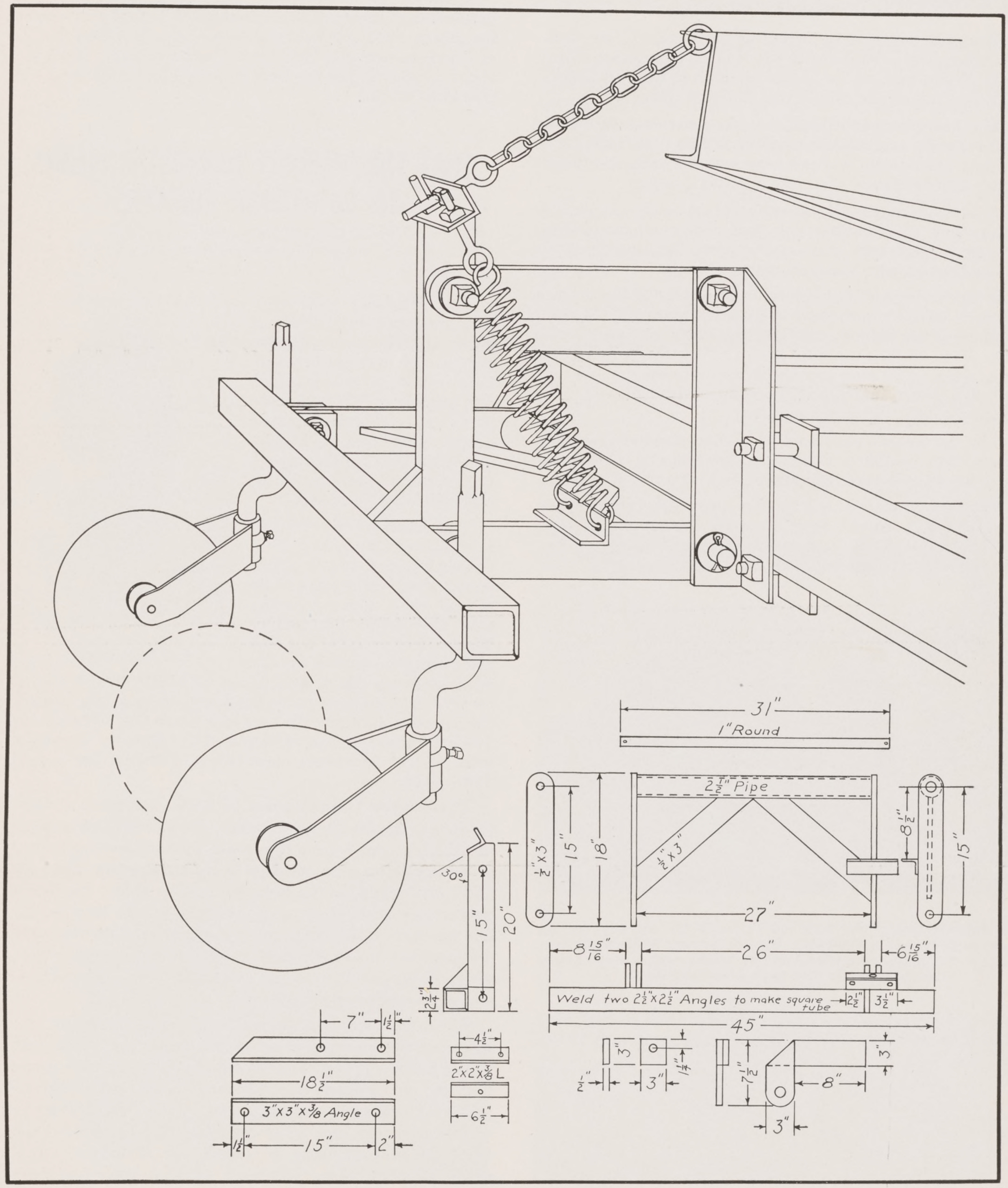
So successful was this operation and because of the insistence of the sugar companies for mechanical harvesters, the International Harvester Company manufactured approximately 300 beet harvesters and delivered them to the customers through their local dealers in the various beet producing states in 1946.

(Continued on page 30)


Control Rope to Operator's
Lengthen Beet Elevator 18"
Platform
③
Burn off Corners of Foliage Conveyor Rear Side Member along this arc
②
Deflector IN Tops fall here
Deflector OUT Tops fall here
③
④
①
②
① Deflector
16 or 18 Ga. Black or Galv.
19"
¾" Pipe
18"
8"
3/8" x 1½"
9½"
1½" x 1½" x 1/8 Angle
13"
45°
12"R
6"
13¾"
17¾"
③ Support Bracket
1½" x 1½" x 3/16" Angle
29"
10"
45°
13"
②
40¾"
4"
5"
17/32" Drill
④
21"
½" Round

Top windrower for the two-row Marbeet Harvester.

***Above*—View of installation.**
***Below*—Details of parts.**



Rear coulter mounting for the two-row Marbeet Harvester.

***Above*—View of installation. (Harvester engine not shown.)**
***Below*—Details of parts.**

INTERNATIONAL

(Continued from page 27)

The only harvesters allotted to the Pacific Coast were ten, which were delivered to the Ray D. Henderson Company, Woodland, who sold nine of them to beet producers in Yolo County and one in the Stockton district.

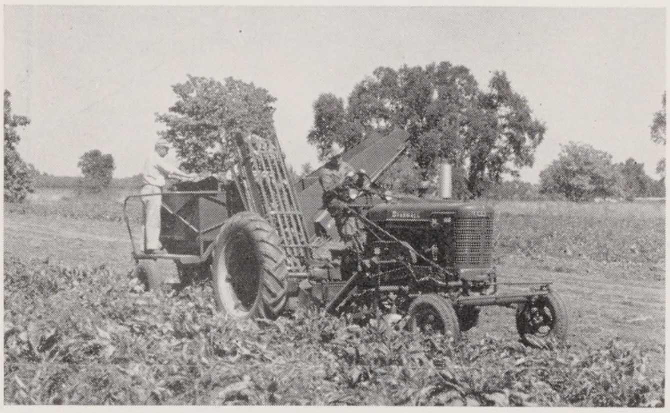
The harvesters sold locally worked successfully in extreme weedy and muddy conditions. The beet lifting and topping mechanism worked very satisfactorily, the "tare" being approximately the same as hand topping.

As is the case with the operation of all newly developed equipment, considerable time was consumed in making proper adjustments and familiarizing the operators of the harvesters with these adjustments.

It was fortunate that the representatives of the manufacturer were conservative in their estimates of the tonnage these harvesters would handle. Their estimates were from 30 to 35 tons per day, but it is reasonable to expect an average of 50 tons per day. With an average yield per acre this should indicate that one harvester could harvest approximately 100 acres per year.

The harvesters were sold in a concentrated area last year so they would receive the required service. There was no delay in operation because of lack of parts or service.

We have been assured by the manufacturer that the harvester will remain fundamentally the same in design but will naturally be improved; and such improvements may be added to the harvesters now in the field.



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The International HM-1 Beet Harvester. Beets are hand-sorted from clods except in light soils. The trailed cart holds about two tons, and is quickly emptied into the trucks, which may remain midway in the field to receive their loads.

Following is a tabulation on the operation of beet harvesters on which we obtained data for the season of 1946:

Owner	Acres	Tons
Heidrick Bros.	100	1500
W. R. Wilder	85	1525
Otto Burgdorf	70	1380
Lloyd S. Burr	90	1350
G. L. Isham	42	850
Brownell Ranch	47	799
Hooker Bros.	60	610
Total	494	8014

It should be of particular interest to California beet growers that International Model HM-1 Beet Harvesters for sale in 1947 will be assembled at the Stockton Works of The International Harvester Company. After 1947, the entire production of the harvester will be handled by the Stockton Works.

WHAT THE MARBEET HARVESTER MEANS TO CALIFORNIA GROWERS

By E. F. BLACKWELDER, *President*
Blackwelder Manufacturing Co.

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E. F. Blackwelder

The Marbeet harvester was developed and built by a group of Delta men with the cooperation and assistance of California sugar beet growers and processors. This harvester was manufactured in sufficient quantities to supply the demand in California and to prove that beets could be mechanically harvested.

The Blackwelder Manufacturing Company was formed and a small plant constructed and equipped at a time when such expansion was considered impossible. We are very proud of our record during the past few years because every Marbeet ordered was built and delivered on time. 213 single row machines and 167 two-row models were produced during the past four years. Our schedule for 1947 is for 65 two-row models and 67 "Juniors," making a total of 617 Marbeets manufactured during the period 1943-1947.

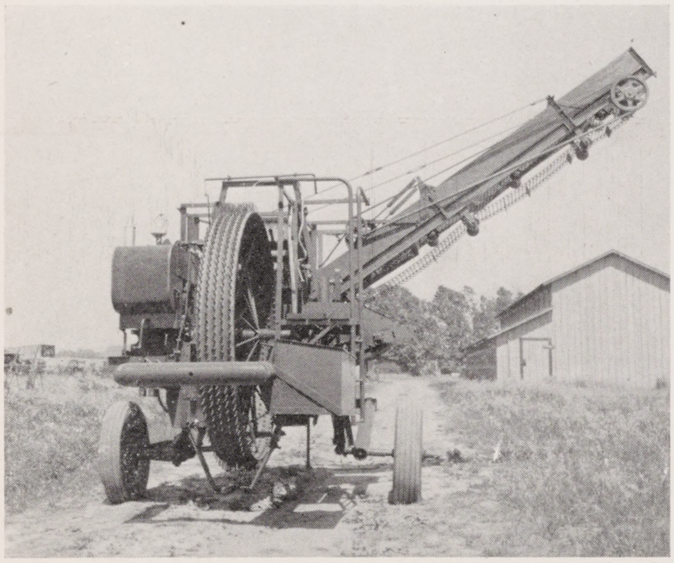
There were 119,121 acres of beets harvested in California during the 1946 campaign, of which 66,155 acres—or 55.5 per cent—were harvested by Marbeet—a record far beyond that accomplished in any other state. With our 1947 production in the field, we predict that a far larger percentage of the beets in California will be handled by our machine. California growers and processors made the 1946 season one of the best on record because they were progressive and flexible and willing to use a new machine to the utmost of its efficiency.

The two-row model has made several outstanding tonnage records, many greater than expectations. A grower in the Salinas area delivered 400 tons during nine hours harvest; ten carloads of sugar beets in one day. With the proper tractor and care, this model will harvest an average of ten acres per day at an amazingly low tonnage cost. With the savings made in comparison with hand labor, many growers claim they have paid for their machines within thirty harvesting days. Add to this the grief avoided by eliminating numerous labor troubles, and it is easy to see why in California the Marbeet two-row is regarded as the machine that kept sugar beet growers in a profitable business.

The "Junior" model of 1946 did not achieve the records made by the larger machine but with the improvements we have incorporated for 1947, we believe it will be found to be one of the outstanding pieces of specialty farm tools used in our fields. Following are a few of the changes we found necessary to make this model the machine we had hoped for: Potato chain elevator, larger water cooled motor, two hydraulic cylinders, heavier crank axle, elevator clutch, improved stripper knives and reinforced front end. These improvements added to the "know how" of efficient operation will insure a 5-acre per day average throughout the season. A great number of these "Juniors" delivered between 150 and 200 tons per day during the 1946 season. These were exceptional results, but we look forward to many more such records for 1947.

The fact that the Marbeet will recover small as well as large beets has made it possible for the planting and thinning programs to be changed so that additional savings can be made. Suggestions from persons who have made a careful study of the sugar beet program indicate that the Marbeet will be the basis of numerous improvements yet to be made which in turn will make beet sugar increasingly competitive with all sugar grown and produced.

Many processors claim that the 1946 campaign was the most successful and pleasant they recall. We—of Marbeet—are proud that we were able to contribute to such an agreeable result at a time when various industries went through the most trying experiences of their history. With more Marbeet harvesters in the field for 1947, we predict that the coming campaign will be the best ever.



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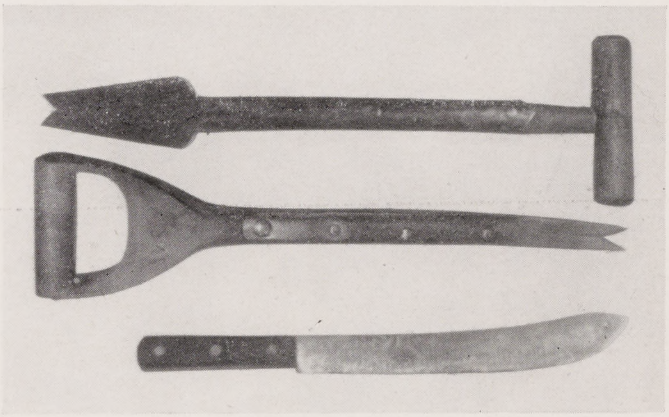
The Marbeet Jr. as modernized by Spreckels Sugar Company for the 1947 harvest. Improvements include a potato chain beet elevator, two hydraulic cylinders, reinforced crank axle, water-cooled two-cylinder engine and steel tool box.

A BRIEF HISTORY OF MECHANICAL HARVEST

The term "Mechanical Sugar Beet Harvest" usually brings to mind a single piece of machinery, delivering clean, topped beets to a truck. One is apt to overlook the many progressive steps which led to this ultimate concept of mechanical harvest, and a glimpse into the past reveals a remarkably complex background behind the present complete sugar beet harvester.

To start at the real beginning of mechanization, it must be realized that sugar beet harvesting was once a truly hand operation—an operation which few, if any, California growers have ever witnessed. The beet fields of Europe were originally hand harvested, and are to this day in some sections. In parts of Holland, each beet is manually lifted with a D- or T-handled prod, the beets laid side by side down the row, and the tops severed with a large butcher knife.

In Germany, beets are often topped in the ground with a sharp hoe and then lifted, one at a time, with a hand fork. (The reader may draw his own comparison with mechanization in warfare.)



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These are the tools used in much of the European beet harvest. Beets are individually hand-lifted with the fork (two types shown above), laid side by side down the row, and topped on the ground with the butcher-knife (below).
(Photo courtesy H. Rietberg)

In a truly unmechanized beet growing area, even the receiving and storage of beets is accomplished without

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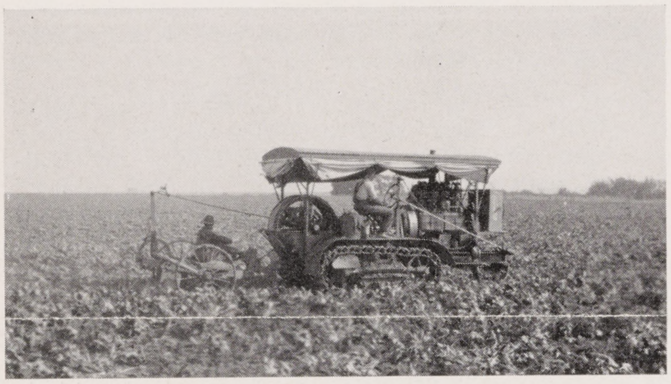
After harvesting their beets, European growers are obliged to store them beside their own fields, in straw-covered "clamps." Deliveries are made as requested by the factories.
(Photo courtesy H. Rietberg)

(Continued on page 32)

HISTORY

(Continued from page 31)

benefit of machinery. European growers haul beets to the factories in horse or ox drawn carts, and fork the beets off by hand. Trucks have but recently begun to replace teams.



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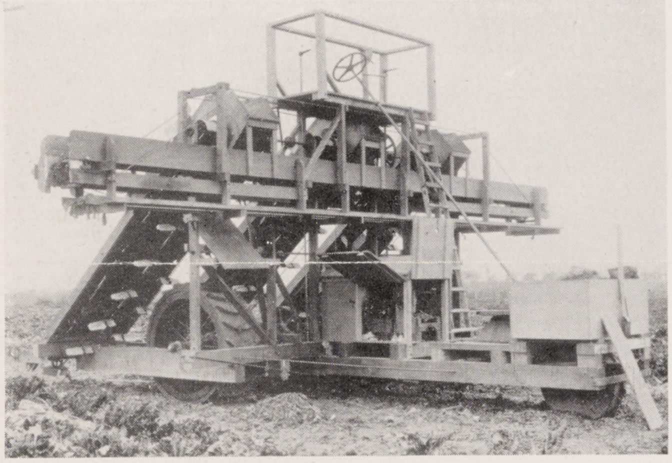
The earliest known beet plow of the subsoiler-with-wings type was this unit built at the Spreckels shops. The tractor is a Holt 75—another of California's contributions to mechanized agriculture.

Beet dumps as we know them in California are not to be found in Europe. To add to the burdens of the beet grower, he is required to store his beets on his own property until the factory is ready to receive them. Many a central European farmer has his straw-covered pile of beets, waiting for the factory's notice to deliver over snow covered roads.

The starting point of harvest mechanization was the horse drawn bow-plow. Operating like an old-fashioned walking plow, it lifted the beets for subsequent hand topping. Next came the riding plow ("Colorado Lifter"), followed by the several types of tractor-drawn plows or tractor-mounted lifters.



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This is evidence of Spreckels Sugar Company's continuous activity in sugar beet mechanization. In 1910, Mr. R. H. Moore, general manager of the Spreckels factory, designed this self-propelled loader. Six hand toppers supplied the beets, which were elevated to a wagon on either side of the machine.

In the United States topping and loading remained the only hand operation, for trucks replaced teams, and unloading facilities were completely mechanized. The half-century during which topping and loading remained as hand operations saw a tremendous activity by inventors, who envisioned the mechanization of these operations. The files of the U. S. Patent Office bulged with over a thousand issued patents on beet harvesting machinery, all filed (and most of them expired) before the present war-born development era made complete mechanization a reality.

Mechanical loaders, picking up hand-windrowed beets, became popular during the late thirties, except in California, where cloddy fields prevented their use.

In 1940 a Pueblo, Colorado, grower, Claude Walz, built a home-made topping and windrowing machine which was the forerunner of the John Deere Sugar Beet Harvester, which windrows eight beet rows for subsequent pickup with the John Deere Loader.

In 1941 the University of California Experiment Station at Davis completed the preliminary groundwork on two types of beet harvesters. The first was a precision machine, limited in its field operation, but capable of topping with greater accuracy than hand labor could accomplish. The second was a cruder machine, using a disk topper and hand-sorting belts to separate beets from clods.

The latter was the inspiration for the McCormick-Deering Sugar Beet Harvester, described elsewhere in this issue.

The Scott-Urshel harvester was built in Columbus, Ohio, since 1938, and was used principally by growers and canners of red beets. It was specialized for sugar beet harvest, and found widespread acceptance in Michigan during 1945 and 1946.

None of the harvesters marketed up to 1942 were suited to California's severe field conditions. In that year, Lloyd and Lewis Schmidt, sponsored by A. L. Jongeneel, developed the prototype of the Marbeet harvester. War conditions had so impaired the quality and availability of hand labor, that the poor topping and beet breakage by the first Marbeet harvester were overlooked in favor of its high productivity. Its general acceptance was as rapid as its mechanical improvement, and it now holds first place in total acreage harvested to date.

THE FUTURE OF MECHANIZATION

That mechanical harvest is here to stay, no one will deny. It is here to stay just as the automobile was here to stay in about 1907, and today's harvesters are in about the same stage of perfection as the 1907 automobiles. Forty years from now, beet harvesters will be comparable in degree of perfection with today's automobiles. There will be this difference, however. No single machine is ever likely to perform at its best in all parts of the country. So, there may well be a variety of types to suit local needs, and the sugar beet industry will ever welcome the advent of a better harvester.

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SPRECKELS SUGAR BEET BULLETIN

PUBLISHED FOR CALIFORNIA SUGAR BEET GROWERS BY THE SPRECKELS SUGAR COMPANY

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THERE'S BEEF IN BEET TOPS

Beet growers who feed their tops can add substantially to their income and promote good soil management.

EACH ACRE OF HARVESTED SUGAR BEET FIELD CAN PRODUCE OVER 100 POUNDS OF BEEF

CATTLE PASTURED IN HARVESTED BEET FIELDS CONTRIBUTE VALUABLE FERTILIZER

PASTURING BEET TOPS MEANS COMPLETE LAND UTILIZATION BY THE BEET GROWER

"Facts About Feeding Beet Tops," appearing in this issue, offers some helpful suggestions to the beet grower who plans a feeding program.

HONEY-DEW

FACTS ABOUT FEEDING BEET TOPS

By JOHN LEAR, *Livestock Specialist*

Spreckels Sugar Company

Sugar beet growers with years of experience in feeding tops have amassed abundant figures concerning the economics of beef production from beet tops.

The beet grower who is primarily a field crop farmer, and who may be undecided on a feeding program, can well benefit from the experienced feeders whose findings are briefed herewith.

FEED VALUE AND YIELD

A beet grower's decision to feed tops will be influenced by current beef market conditions. At this writing, there is a relatively small spread in the selling price of fat cattle as compared to feeders. Compensating this situation is the high cost of feedstuffs, and an analysis of the feed value of beet tops is in order.

About 40 per cent of the dry matter of the tops is in the crowns, and 60 per cent in the leaves. In 100 pounds of tops on dry matter basis there are 7 to 9 pounds of digestible crude protein, and 60 to 65 of T.D.N. (Total Digestible Nutrients). Under field feeding conditions beet tops may not analyze that high due to overcuring of leaves, trampling, etc.

The tops from a ton of beets, with average size crowns, should yield the equivalent of about 700 pounds of alfalfa hay. An average tonnage of beets around 15 tons yields on the average two tons of cured beet tops. With alfalfa hay at $27.50 per ton, the beet tops have a replacement value of approximately $10.00 per ton. Two tons of tops, then, are worth $20.00 per acre.

These figures are based on the hand topping method, and with machine topping, which is the most common now, there may be more or less crown and considerably more dirt. The windrowing attachment reduces damage done by the harvesting equipment in running over the tops. On the expense side of the ledger, there are the costs of building fence, paying a rider, and the ever important water system.

There is no indication at the present time that the beet top feeder will gain financially by stacking or siloing tops for the feed lot. With the present cost of labor plus difficulties encountered in the mechanics of handling tops for storage, little interest is being shown by feeder or grower. There is also always the thought that there are not enough early winters in the California valleys to justify piling, siloing, or stacking.

GENERAL INFORMATION AND COMMON PRACTICES

Since the feeding period usually runs from 50 to 90 days and the gain from 1 to 1½ pounds per day, two- and three-year-old steers, heifers, and mature cows are the only type of stock which attain satisfactory slaughter condition.

Tops from 1 to 1½ acres of beets yielding 15 to 20 tons will support one animal up to 75 days.

Cattle should not be allowed to roam at will over a large field. By using temporary cross fences, one can have smaller fields and move the stock often to fresh feed.

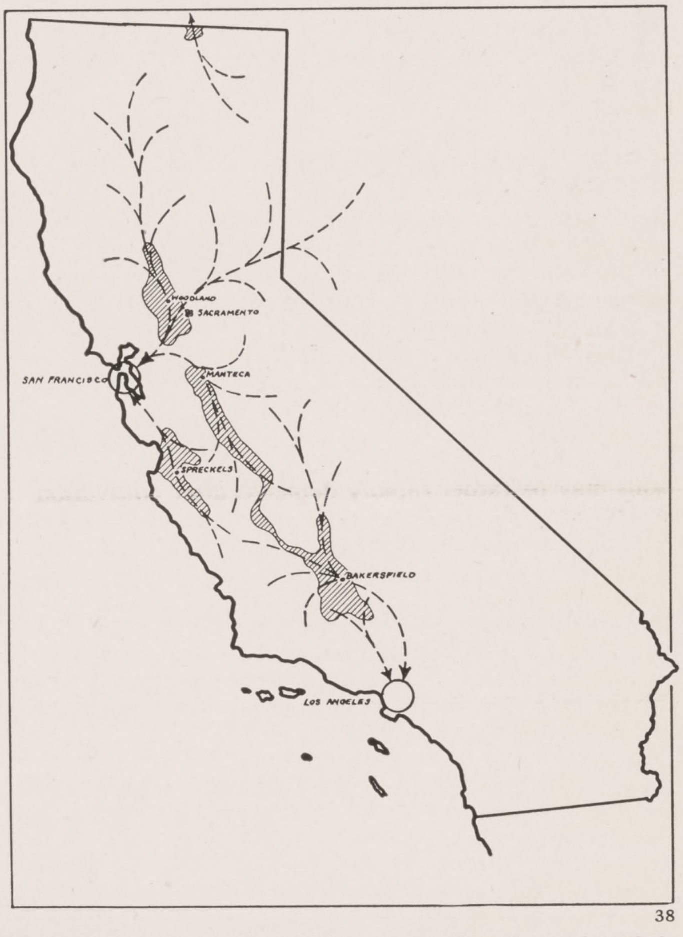
Tops often require 5 to 7 days of curing before pasturing. The pasture area should be limited by fencing to get the best utilization, and the animals moved every 7 to 14 days. Keen judgment is a prerequisite to feed utilization; feeding a field a day too long may cost pounds of gain.

Consumption of water, especially during hot weather, is high. Water loss when feeding tops is large through feces and urine. If possible, drinking facilities should be arranged so that cattle can walk up and down parallel to the rows instead of across to decrease trampling and wastage—a condition which is encouraged when tops are windrowed. When available, and if practical, hay stubble or supplementary grain increases gain.

One hazard of feeding tops is the choking and bloating caused by small beets and hard crowns lodging in the esophagus. Animals should be watched during morning and evening feeding periods or losses may follow. By using a well lubricated hose or a rounded wire, the lodged beet or crown can be pulled out or pushed down the esophagus. Some feeders think it is advisable to take an animal thus injured directly to the slaughter house, particularly if blood comes from the choked animal's throat.

TOP FEEDING AND THE MARKETING CYCLE

Range fed cattle travel to marketing centers over routes which traverse the beet growing areas of California. It is evident from a glance at the accompanying map that little or no transportation expense is incurred in bringing cattle to beet growing areas.



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The shaded areas on this outline map of California are Spreckels beet growing areas. The broken lines approximate the routes over which cattle move from range lands to the principal marketing centers. All main routes of cattle shipping traverse the beet growing areas, thus minimizing transportation costs when feeder cattle are finished or "warmed up" on beet tops.

In seasons of early range depletion, the state's sugar beet fields offer a valuable reservoir of stock for late fall slaughter or winter fattening.

Where cattle are to be fattened on a ration including beet pulp, pasturing in harvested beet fields offers a valuable "warm-up" period during which range animals acquire a healthy appetite for beet by-products and enter the fattening pens with a taste for pulp acquired in the beet fields.

THE PHILOSOPHY OF SOIL MANAGEMENT

By L. E. DAVIS, *Associate Professor of Soils*
University of California

The use and management of soil is one of the oldest arts of mankind. Nevertheless, there are still problems which have not been completely solved. Both practical farmers and so-called experts express differing opinions about many practices. To some extent soil management is a philosophy rather than a well established science. Perhaps the following remarks should be considered as an example of this situation.

Are Our Soils Deteriorating?

Intensive agriculture is relatively recent in California. Soil fertility is generally high in this state, where fertilizer consumption per acre is much lighter than in many parts of the country. Is the fertility of our soils gradually decreasing as the result of continued cropping? This question is difficult to answer.

It is frequently assumed that, after all, there is just so much plant food in a soil. After it is used up, what then? This idea is not entirely unsound. There is plenty of evidence to show that in many cases the readily available supply of nitrogen, phosphorus, or potash in virgin soils may be rather rapidly depleted after cultivation.

On the other hand, many of our valley soils have an almost inexhaustible supply of *reserve* plant food, which is slowly becoming available, while the *readily available* elements are taken up by the crop. Nevertheless, field trials may show a crop response to fertilizers. It seems that this is not merely a matter of bookkeeping, that is, of restoring exactly the amount of plant food removed by the crop. The fertilizer acts as a booster, particularly during the early season when root development is still restricted.

It is not entirely true that the soils of Eastern and Southern states which use great quantities of fertilizer are low in fertility primarily because of intense cropping. In regions of higher rainfall, soils tend to be naturally less fertile than in drier areas. The pure rain water leaches plant food out of the soil, especially in forest soils.

We are becoming more fertilizer conscious in California. This may be due to a real progressive decrease in fertility, which is called to our attention by decreasing crop yields. However, it may be partly the result of increased knowledge as more and more fertilizer trials are set up. An analogy is found in the field of medicine, where *apparent* increases in the extent of certain diseases are often due to the fact that more cases are brought to the attention of doctors.

In any event, it seems that, with an intelligent use of fertilizers, including the minor elements (when they are dificient), no serious decrease in soil fertility is likely to occur in the near future.

One good rule to follow is: If you don't know that you need or do not need fertilizers, try them out, using checks without fertilizer along with plots that are fertilized. In other words, try experiments!

ORGANIC MATTER AND THE SOIL

The importance of organic matter, i. e., barnyard manure, green manure, etc., in the soil is a much disputed point. Many extreme views have been expressed, ranging from the idea that organic matter is of no great consequence to the concept, stated with almost religious fervor by others, that all applied plant food should be in the form of manure or compost and that commercial fertilizers are "poison."

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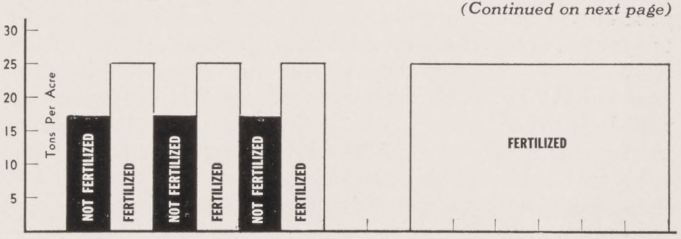
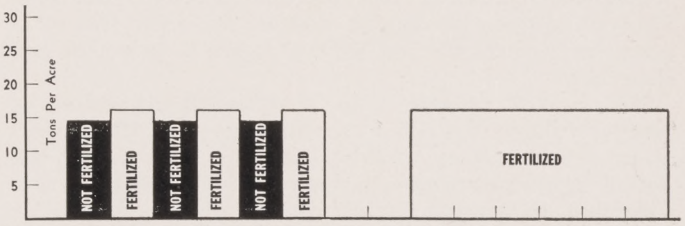
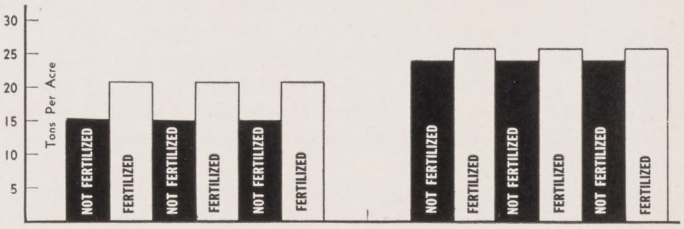


These figures illustrate a fertilizer trial which indicates a real gain from the use of fertilizer. The tall blocks on the left represent fertilizd plots. The short blocks represent check plots which were not fertilized. The tall rectangle on the right suggests the yield for the whole field in succeeding years under fertilization. Naturally the farmer wishes he had fertilized the entire field instead of trial strips. However, see the next diagram!



These figures illustrate a fertilizer trial which shows an unimportant gain from the use of fertilizers. The cost of fertilizing the whole field without a trial would represent wasted money. The difficulty is that yields vary from season to season because of many factors, such as weather, management, etc. This situation is illustrated in the next diagram.



These figures illustrate two fertilizer trials carried out in different years, and in different fields. The figure on the left represents a trial which happened to be carried out in a poor year. Nevertheless, since this field needs fertilizer, a real gain is seen. The figure on the right represents a trial carried out in a very good year. There is no real gain which can be attributed to fertilization. But if the whole field had been fertilized, the crop would have been very good and in the absence of check plots one might have assumed erroneously that the good yield was due to fertilization.

SOIL MANAGEMENT

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Aside from these extreme attitudes a number of careful experiments have been carried out in various parts of the world. The results are not always consistent or easy to interpret. So much depends upon such factors as climate, when the rainy season occurs, kind of organic matter, when it is disked or plowed in, kind of soil, intensity and frequency of tillage, and irrigation practices.

One cannot make a sandy loam soil out of an adobe clay soil by disking in a cover crop. In a warm, dry climate it is not possible to maintain a high content of humus in a soil by applying amounts of organic matter which are economically feasible. On the other hand, the judicious use of organic matter frequently (not always, perhaps) tends to open up tight, compacted soils. Drainage, aeration, workability, and root penetration may be improved.

One naturally assumes that the regular use of cover crops, disked under as green manure, or the application of barnyard manure is desirable. Statements to this effect can be cited from most textbooks on soils. Such ideas are probably true in a broad sense. Fresh, young legume cover crops are rarely, if ever, undesirable. Plant residues which have a low nitrogen content are not always desirable. One should avoid an extreme attitude. For example, one well-known text even states dogmatically that the disking in of green manures *must* be carried out to prevent a decline in productivity. Such dogmatic statements are not borne out by experience. Excellent, progressively increasing crop returns have been reported for years from farms which have not carried out manuring of any type.

Apparently, when the soil structure has deteriorated so that a soil is tight and compact, the incorporation of organic matter will generally bring about some improvement. It seems probable that when this improvement has once been attained it can be maintained without continued additions of organic matter, *provided that it is practicable to till the soil without again injuring the soil structure.*

We cannot present here a detailed discussion of "proper" tillage and cover crop management. Ideal operations are not always practicable. To a large degree the practicing farmer must rely upon his own experience and judgment. In general he will wish to disturb the soil as little as possible, certainly not when wet. He may or may not find it desirable to plant cover crops and disk them in from time to time to restore the condition of the soil.

THE USE OF SOIL CORRECTIVES

It is very difficult to discuss the effect of soil correctives in a brief statement. Two of the most important uses of such materials as sulfur, lime, and gypsum are (1) the opening up of tight soils, and (2) the reclamation of alkali soils. Lime is also used to correct excessive acidity, while sulfur is used to make a soil less alkaline or even to produce acid soils.

The most common corrective for tight, compact soils is gypsum, which is a neutral compound of lime and sulfuric acid. It is not effective in neutralizing soil acidity or alkalinity. Lime is also useful to open up tight soils and is probably as effective as gypsum. Most soils which contain natural supplies of lime are friable. Compact soils which are also acid should be treated with lime.

It has been shown that alkali soils can be reclaimed with good drainage, plenty of relatively hard water, and a cover of alkali resistant plants. Sandy, easily drained, *white* alkali soils probably need nothing else in the way of treatment in most cases. However, heavy white alkali soils are saline soils which are also either neutral or acid soils. They contain such substances as common table salt.

Black alkali soils are basic soils which may or may not be saline. An example of a basic substance (sometimes called an alkaline substance) is washing soda. Black alkali soils usually contain some washing soda, but not necessarily much common salt. They can be reclaimed with good drainage, irrigation with relatively hard water, and an alkali resistant cover. However, gypsum, sulfur, sulfuric acid, or lime greatly speed up the process. It is usually worth while to apply such correctives to black alkali soils.

Some true alkali soils contain appreciable amounts of lime. Such soils can probably be reclaimed with good drainage and soft water or slightly saline water. On the other hand, there is good reason to believe that soft, nonsaline waters may be dangerous if applied to alkali soils which contain no lime. If such water is used on soils of this type, gypsum or lime should be applied.

Finally, it may be suggested that probably sulfur or sulfuric acid should not be applied to soils which are low in lime unless some gypsum is also applied, or the water used is hard water.

Any farmer who contemplates the reclamation or correction of soil will realize that the problem is complex and should be considered from several angles. Can drainage be installed? Will it be adequate if neighbors have high water tables in undrained land? What will be the probable effect of the kind of irrigation water which is available? What kind of alkali is present? Is the soil a light sandy soil or a heavy clay soil? Each case requires a careful study. Problems cannot be solved by oversimplifying them. Disking in some magic chemical mined somewhere in the hills is not a panacea.

In conclusion, it may be suggested that the philosophy of soil management is: Use common sense. Don't take anything for granted without considering it from different angles and trying out some of the ideas. Don't be afraid to try new ideas, but don't go "hog-wild" over them.

WHAT IS THE BEST ROW SPACING?

By AUSTIN ARMER, *Agricultural Engineer*
Spreckels Sugar Company

For nearly half a century, sugar beet growers the world over were content to plant their crops in rows averaging 20 inches apart, with beets spaced 10 or 12 inches apart in the rows. When mechanical harvesting entered the picture in California, many growers took liberties with this time-tried row spacing in order to facilitate the use of harvesting machinery. Few growers admitted reduced yields—some even claimed increased yields from wider rows.

The question is naturally raised: What is the significance of population and distribution of beets?

The origin of the 20″ x 10″ planting pattern is lost in antiquity. It has been suggested that rows may have been originally spaced the length of two footprints apart, with one footprint between beets. European practice may have set the convenient ratio of ½ meter by ¼ meter (19.68″ x 9.84″).

Whatever may have been the origin of this traditional planting pattern, its ability to produce the maximum sugar per acre has been repeatedly proved by exhaustive experiments conducted in beet growing areas in all parts of the world.

Abundant information is on file, and for the purpose of this discussion, data were examined which resulted from recent experimental plantings at Woodland, California; Granger, Utah; and the light clay soils of Holland.

The collected data were analyzed to obtain answers to these two questions:

1. How does sugar per acre vary with population of beets per acre?
2. For a given population, how does sugar per acre vary with distribution of plants?

Considering the wide variations of fertility level, length of growing season and type of seed which existed at these widely separated experiment locations, a definite similarity of answers was obtained. The answers may be briefed as follows:

1. Sugar per acre drops sharply when population falls below 25,000 beets per acre.
2. Sugar per acre is reduced when distribution ratio (ratio of row spacing to spacing in the row) increases beyond 2.0.

These findings completely justify the traditional 20-inch average row spacing and 10- to 12-inch spacing in the row. This pattern gives a population between 26,000 and 31,000 beets per acre, and the distribution ratio varies from 1.67 to 2.0.

Absolute maximum sugar per acre would be obtained with 16-inch rows and 16-inch spacing in the row, but

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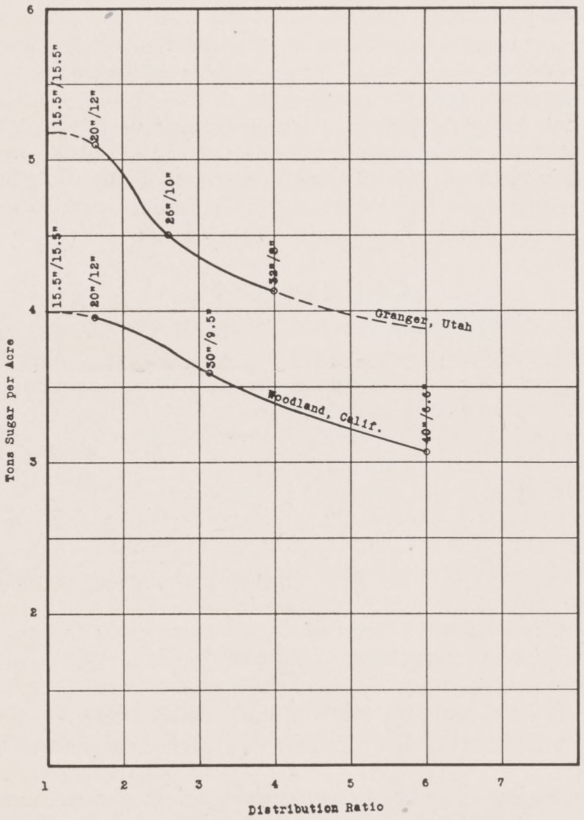
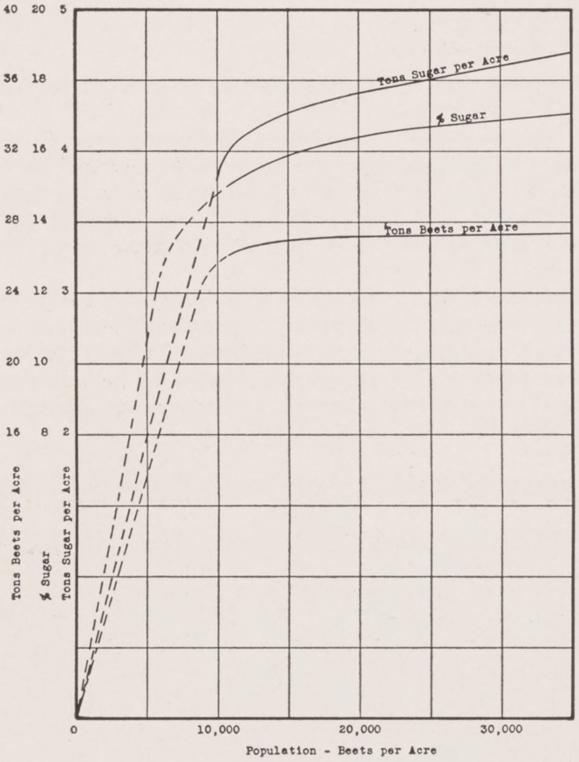
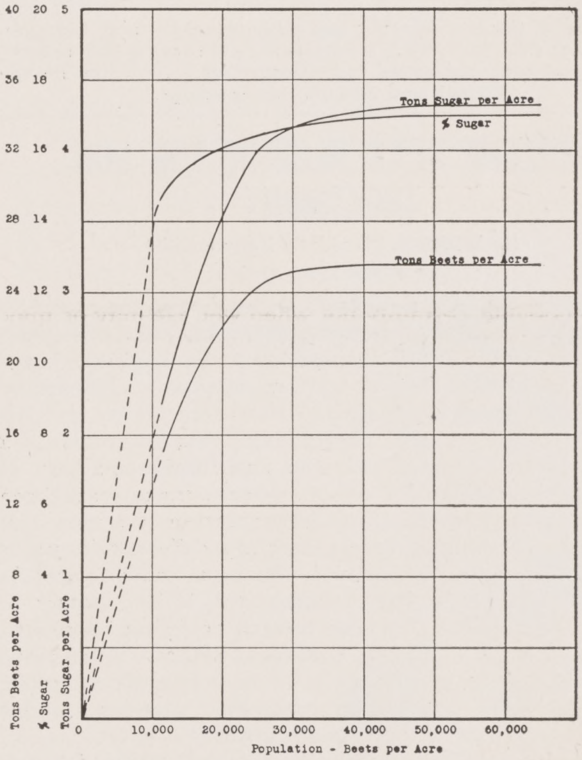


These curves show the effect of Distribution Ratio on tons of sugar per acre. (Distribution Ratio is the ratio of row spacing to spacing in the row.) Note the similarity of trends between experimental data from Woodland, California, and Granger, Utah.



These curves show the effect of beet population on tons of beets per acre, sugar percentage, and tons of sugar per acre.

(Data from experiments conducted at Granger, Utah, in 1945, by the Utah-Idaho Sugar Company.)



These curves were plotted from data covering extensive experiments in Holland. Note the similarity of trends as compared to the Granger, Utah, experiments.

(Data from "Medeelingen Van Het Instituut Voor Suikerbietenteelt," Bergen op Zoom, Netherlands, June, 1934.)

ROW SPACING

(Continued from page 37)

the increase is neglible in comparison to 20-inch by 10- or 12-inch distribution.

Row spacings much wider than 20 inches (say, 26 to 36 inches) will reduce sugar yield markedly, even if beets are spaced closer in the row. Such wide row spacings should therefore be used only when considerable cost savings in cultivation, weed control and harvesting can be assured.

Readers wishing to visualize the foregoing relations may study the curves published herewith. These curves reveal closely similar trends regardless of where the experiments were made, and are believed to be a sound basis for evaluating row spacing, population and distribution in terms of yield in sugar per acre.

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A portion of the row-spacing and population plots at Granger, Utah (June 20, 1945). Each treatment (row spacing and spacing in the row) was replicated four times. This view contrasts the 20-inch and 39-inch row spacings.

BENZENE HEXACHLORIDE FOR SOIL TREATMENT

By ROSS S. MILLER, *Entomologist*
Chemurgic Corporation

Extensive trials of new insecticides during the past two years have shown that certain soil insects can be successfully and economically controlled with benzene hexachloride, otherwise known as hexachlorocyclohexane or "666." Only small quantities of this material are needed to kill wireworms and centipedes. This chemical is a powder having contact, stomach, and fumigant action. It has an initial fumigation effect and remains at least three months in the soil. Benzene hexachloride is a chemical compound containing several slightly different forms or isomers. The gamma isomer is the most toxic to insects and commercial products express the killing power in terms of this isomer. Benzene hexachloride has been used on many crops, including potatoes, without deleterious effects, but may impart an odor to certain root crops grown for table use unless used with care and under proven conditions for any given locality.

Many early compounds were objectionable for soil treatment due to the strong odor of the material. However, modifications in the manufacturing process has resulted in a greatly improved product over previous materials.

WIREWORM CONTROL

For most soils, an application of benzene hexachloride designed to give one pound of the gamma isomer per acre prior to planting will give excellent control. For wireworm control on peat soils, poorer results have been obtained than on other type soils. Indications are that a higher concentration of the gamma isomer per acre may be required on these soils. This can be applied as a spray or a dust. Regardless of which method is used, uniformity of application is of the utmost importance.

The most satisfactory method of application is in the form of a spray. A boom sprayer similar to equipment used for weed control is used. Usually a uniform application can be obtained with as little as 100 gallons of water per acre. This may be applied as 16 pounds per acre of the wettable powder containing 6% of the gamma isomer. This is followed by cross-disking to a depth of 6 to 9 inches.

Benzene hexachloride has also been used commercially as a seed treatment during the past season with varying degrees of success. Because of the short history of this practice, no definite recommendations can be made for particular plantings. Treatment of sugar beet seed with 0.1% pound of gamma isomer per 100 pounds of seed has given protection against wireworm and centipede without loss of germination and is recommended for large scale experimentation.

When treating seed, the dry material is preferable, and if moisture is considered necessary for adherence, a small amount of water may be sprayed on after the dust and seed are thoroughly mixed.

Several applications have been made with the benzene hexachloride incorporated into fertilizer mixes with favorable results. One limiting factor of this practice is the fact that the optimum time for fertilization might not be the optimum time for wireworm control. At the present time this type of control may necessitate a grower's formula, since local fertilizer recommendations will govern the gamma isomer content of the material.

CENTIPEDE

Recent results show benzene hexachloride can be used as a soil treatment for the control of centipedes. Due to the variation in results under different local conditions, further conclusive results are needed before definite recommendations can be made. On the lighter type soils, economical control has been obtained with the recommended dosage and methods of application given above under wireworm control. Preliminary results of field tests indicate that a combination of benzene hexachloride and DDT may be the more efficient, the DDT giving a longer residual kill.

Good results have been obtained using benzene hexachloride for seed treatment as a control against centipede injury on a variety of crops. Further work will lead to more definite recommendations. On sugar beets the dosage given for wireworm control will probably give good results.

The future of benzene hexachloride holds most promising large scale uses on a number of different soil insect pests. The problem of wireworm and centipede control has come within the economical limits of every farmer plagued by these pests through the use of this new insecticide.

SUGAR ACT OF 1948

By B. H. BENIDT, *Special Assistant to the President*
Spreckels Sugar Company

The Sugar Act of 1948 became law on August 8, when it was signed by President Truman. The new Act covers a period of five years from the December 31, 1947, termination date of the old Sugar Act, and is very similar to it in all essential features. Protection of the domestic sugar industry is continued by preventing world surplus sugars from disturbing the United States market.

Under the Act, the Secretary of Agriculture is required to establish the total amount of sugar that may be marketed in the United States from all supplying areas each year, and, of course, the total supplies thus made available to consumers determine the price level. The Act directs the Secretary to set the total of all quotas in such amount so that the resulting prices will fairly and equitably maintain and protect the welfare of the domestic sugar industry, but at the same time not be excessive to consumers.

Of the total supply to be made available, the domestic areas and the Philippine Islands are each given basic quotas, with Cuba supplying practically all the balance. The domestic beet sugar area's basic quota of one million eight hundred thousand short tons raw value, or 33,645,000 one hundred pound bags of refined, is about equal to the high average production of beet sugar in the United States in the three years just prior to our entry into World War II, 1938, 1939 and 1940. When available supplies in any area exceed the quota, the Secretary is authorized to impose marketing allotments on the persons producing or importing the sugar so that not more than the area's quota will be marketed.

As a means of implementing the quotas, provision is made for the making of Government conditional payments to domestic producers of sugar beets and sugarcane. Growers must meet the following conditions in order to be eligible to receive full payments:

(1) Except for the grower's own children, no child under fourteen years of age can be employed in the production of sugar beets or sugarcane; (2) wage rates of not less than those established by the Secretary of Agriculture to be fair and reasonable must be paid for work in producing the crop; (3) prices that the Secretary determines to be fair and reasonable must be paid for sugar beets and sugarcane by producers who are also processors; and (4) the grower's sugar beet or sugarcane acreage must be confined to the allotment established for his farm by the Secretary. The soil practice condition in the old Act has been eliminated.

Restrictive acreage allotments are not generally imposed unless the area (continental beet area, continental cane area, Hawaii, etc.) in which the grower's farm is located has been producing in excess of its marketing quota. When restrictive acreage allotments are necessary, two standards are provided for dividing up the total permitted acreage; namely, acreage or production history and ability to produce.

Payments of 80 cents per hundred pounds of sugar commercially recoverable from the sugar beets or sugarcane are authorized for all production up to 350 tons of sugar, raw value. Payments on larger production are gradually reduced until production exceeds 30,000 tons of sugar, where the payment rate remains constant at 30 cents per hundred pounds. On 17 percent beets, the payment would be about $2.58 per ton on the first 2,165 tons of beets produced, $2.42 per ton on the next 2,165 tons, and $2.26 per ton on production between 4,330 and 6,190 tons.

In addition to the payments on sugar beets and sugarcane produced, payments are also authorized on 80 percent of the normal yield when through no fault of the grower his yield and the yield in the community generally are poor because of drought, flood, storm, freeze, disease, or insects. Payments on one-third of the normal yield are also authorized when acreage is abandoned due to the same causes as mentioned above.

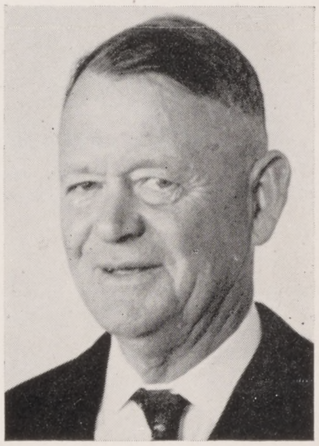
A further means of implementing the sugar quota provisions is provided by the collection of an excise tax of 53½ cents per 100 pounds on all sugar manufactured in the United States and by a compensating tax of the same amount on all imported direct consumption sugar. The tax money goes directly into the United States Treasury and the money needed for the payments to growers must be appropriated by Congress, but more total money is collected by the tax than is needed for payments to domestic growers.

VETERAN AGRICULTURAL STAFF MEMBERS RETIRE

Spreckels Sugar Company recently announced the retirement of three men on the District 2 agricultural staff.

Although in two cases retirement age had been reached previously, the men remained in the service of the Company through the war years. The extra years they put in are deeply appreciated by the Company as well as the growers they served.

Spreckels Sugar Company proudly presents the retiring men and their records:



Dan Burr, Field Superintendent, was born in South New Berlin, Chenango County, New York. He came to California in 1889 and attended the University of California at Berkeley. He started to work for the Spreckels Sugar Company in 1898 as a rod man on a surveying crew, returning to college in 1899 for two more semesters. He resumed his connection with the Spreckels Sugar Company in 1900 as Ranch Bookkeeper and Beet Inspector in the Salinas District and in 1905 became Ranch Superintendent for one of the Company ranches. He was made Field Superintendent in 1921, in charge of the northern territory of the Salinas District, and in 1926 was transferred to the Sacramento District.

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STAFF MEMBERS RETIRE

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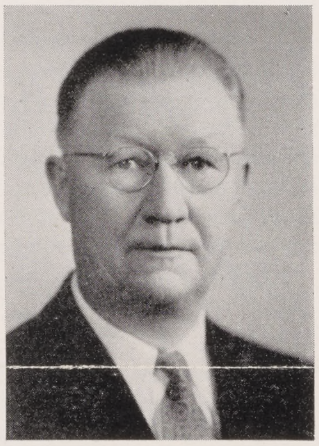

Alexander L. Knudsen, Labor Superintendent, was born in Rochester, Minnesota. Following business college, he opened his own business in 1903 at Winona, Minnesota. In 1908 he opened a real estate business in Phoenix, Arizona, and in 1911 accepted the position as clerk for the U. S. Postal Service. He became U. S. Customs Service Inspector at Nogales, Arizona, in 1913 and, in 1916, Inspector for the U. S. Immigration Service. After coming to California in 1924, he accepted a position as Labor Superintendent with the Spreckels Sugar Company with headquarters in Manteca. He was transferred to Salinas in 1925 and to Sacramento in 1927.

Robert L. Merchant, Field Superintendent, was born in Lee Summit, Missouri. He started his career in sugar beet work in 1905 when he became connected with the Hamilton Sugar Company at Hamilton City as Ranch Superintendent. He became Field Superintendent for the Alameda Sugar Company at Alvarado in 1914 and in 1917 was Ranch Superintendent for the Amalgamated Sugar Company at Tracy. In 1920 he was Ranch Superintendent for the Los Alamitos Sugar Company and in 1924 was employed by the Holly Sugar Company at Santa Ana. He joined the staff of the Spreckels Sugar Company in 1931 as Field Superintendent.

John Bryan, formerly of the Sacramento district, has been transferred to the Walnut Grove-Isleton district and John Lear has taken over a portion of the Woodland district.

IMPROVED BEET DUMPS BUILT IN 1947

Pursuing its policy of improving beet receiving facilities as rapidly as materials became available, the Spreckels Sugar Company completed four new beet dumps in 1947. They are located at Grimes, Los Banos, Cromir and Arvin.

Material shortages of the war years continued to be a problem, and the new dumps reflect the ingenuity of the Agricultural Department in combining serviceable parts of existing dumps with new parts and materials as they became available.

All of the new receiving stations embody the same basic design features, including enlarged scale platforms, easy approach grades and large capacity hoppers with rapid discharge feeder belts.

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The new beet dump at Grimes is one of four built in 1947. In addition to important mechanical improvements, a harmonizing color scheme highlights the installation.

The SPRECKELS SUGAR BEET BULLETIN is published bi-monthly by the Agricultural Department of the Spreckels Sugar Company as a service to its growers.

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SPRECKELS SUGAR BEET BULLETIN

PUBLISHED FOR CALIFORNIA SUGAR BEET GROWERS BY THE SPRECKELS SUGAR COMPANY

Vol. XI NOVEMBER-DECEMBER 1947 No. 6

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BEETS WITHOUT WEEDS

Pre-emergence spraying experiments point toward noteworthy savings in hoeing and cultivating costs. While now in the experimental stage, pre-emergence spraying may become common practice for growers who plan a judicious planting and spraying program.

NOT SPRAYED
Beet seedlings emerging into a mass of weeds.

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PRE-EMERGENCE SPRAYED
Beet seedlings emerging with no weed competition.

PRE-EMERGENCE SPRAYING TO CONTROL WEEDS IN SUGAR BEETS

By PROF. W. W. ROBBINS *and* PROF. ROY BAINER
College of Agriculture, University of California

(Reprinted from "California Agriculture," October, 1947)

Preliminary field tests on the University Farm, Davis, indicate that pre-emergence spraying offers promise as one method of controlling weeds in sugar beets. Moreover, the method may be applicable to other row crops.

The field tests were as follows: In December the field was disked and floated; a portion of the area was left flat, the remainder ridged and formed into beds; the field was left in this condition throughout the winter; seedings to sugar beets were on February 24 and March 12. At the time of seeding there was a good growth of various winter weeds, mostly in the seedling stage. Decorticated sugar beet seed was drilled in at three different depths: 1 inch, 1½ inches, and 2 inches. A precision drill was used, the seeding rates ranging from 4 to 5 pounds per acre.

There was no disturbance of the soil prior to seeding; the seed was drilled through the weeds. This point is worthy of emphasis. It is known that with most weed species only those seeds germinate which are within the upper ¼ to ½ inch of soil. If, as is the usual practice, the first crop of weed seedlings is destroyed by cultivation, the stirring of the soil brings more weed seeds near the surface and soon another crop of weeds appears. Prior to emergence of the sugar beet seedlings, the entire plot area was sprayed with several different general contact weed killers. These are shown in the accompanying table.

All treatments were applied at the rate of 50 gallons per acre, except numbers 1, 2, and 7, which received 30 gallons per acre.

The results may be summarized as follows:

1. All applications gave a satisfactory weed kill.

2. The rate of kill was more rapid in the case of those sprays which were "fortified" with either Dow General, sulphur, or pentachlorophenol; and, the rate of kill increased with an increase in the amount of oil the mixture contained.

3. Little injury to emerging beet seedlings resulted from any of the applications when they were applied about 6 days before their emergence; injury to beet seedlings occurred, however, when the materials fortified with Dow General and pentachlorophenol were applied one or two days prior to emergence. (See *Table* giving germination stand counts.)

4. The sugar beet seedlings in sprayed plots developed in relatively weed-free soil, and without the competition which young weeds cause. These beet seedlings soon surpassed those which emerged in unsprayed plots in which beet seedlings entered into competition with weed seedlings.

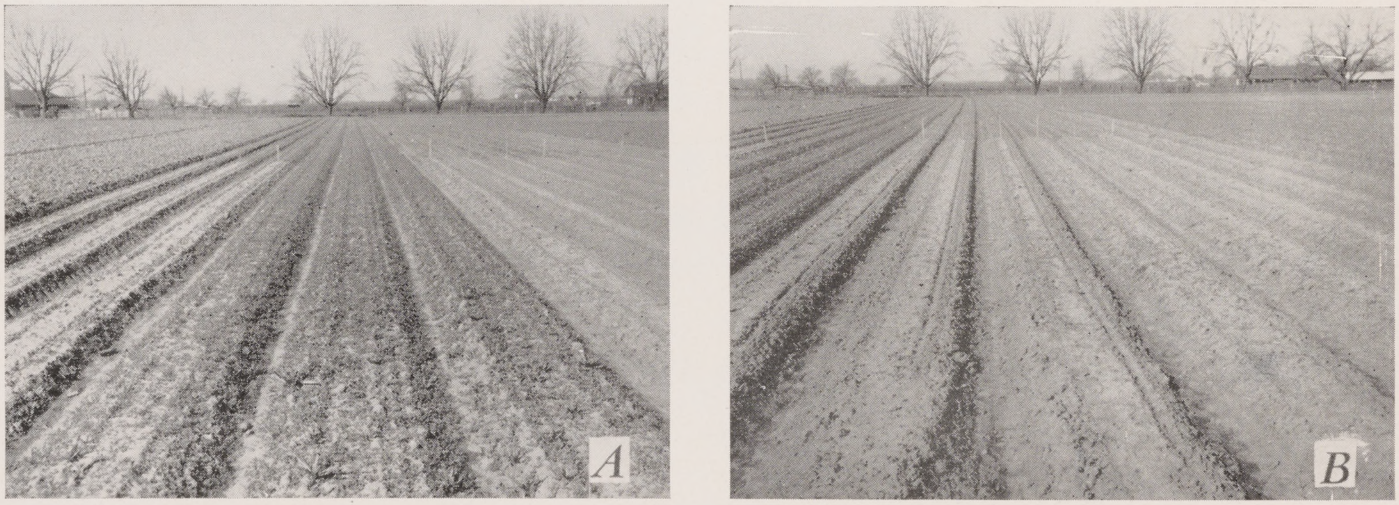
5. Cultivation of sprayed plots was not necessary until well after thinnings.

6. The cost of blocking and thinning sprayed plots was much less than that on unsprayed plots.

7. Analysis of germination stands resulting from different seeding depths shows a greater percentage of "singles" from seeds at 2 inches than from these at shallower depths.

Advantages of pre-emergence spraying, based upon the above preliminary field tests, appear to be as follows:

(1) It permits the preparation of seed beds in the fall, their subsequent settling during the winter, and seeding without any preliminary treatment, that is, re-working of the beds.



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A, weed growth at time of spraying; B, after spraying. Beet seedlings appeared in these plots within 5 to 6 days after spraying.

(2) The beet seedlings emerge in a weed-free soil, and lacking competition, make rapid, vigorous growth.

(3) The first cultivation after emergence may be delayed until the seedlings have attained considerable size.

(4) It favors the use of the precision drill, and a low rate of seeding.

(5) It reduces the cost of blocking and thinning, probably making possible the accomplishment of these two operations in a once-over with the long-handled hoe.

It appears from these preliminary tests that it is highly advantageous that weeds be sprayed when small (1 to 2 inches high) and succulent. Weeds that make their growth during cool, moist weather are less resistant than those of equal size that develop during warm, dry weather. The more resistant weeds, including weedy grasses, require fortified oil.

The fortifying reagents and the emulsifier, even though required in small quantities, add considerably to the cost of the spray materials, but at the same time increase their effectiveness. Further field tests this coming season will aim at reducing costs, and adapting equipment and methods of application to pre-emergence spraying.

There are indications that if pre-emergence spraying is to be practiced, beet seeds should be planted deeper than usual (soil and weather conditions permitting), in order to delay their germination and to secure a greater percentage of "singles."

AVERAGE RESULTS OF PRE-EMERGENCE SPRAYS
PER CENT GERMINATION STANDS
ALL DEPTHS OF PLANTING AVERAGED

Treatment	Seeding Date—Feb. 24. Herbicide applied 1 to 2 days before emergence of beet seedlings. % Germination Stand	Seeding Date—March 22. Herbicide applied about 6 days before emergence. % Germination Stand
1. Diesel oil (straight)	44.8	65.1
2. Diesel oil and Dow General* (1 qt. to 30 gals. of oil)	14.8	53.4
3. Diesel (1 part), water (4 parts), and emulsifier	47.0	47.4
4. Diesel oil (1 part), water (4 parts), Dow General (1 qt. to 30 gals. of mixture), and emulsifier	——	56.4
5. Diesel oil (1 part), water (9 parts), Dow General (1 qt. to 30 gals. of mixture), and emulsifier	10.4	52.8
6. Diesel oil (1 part), water (1 part), Dow General (1 qt. to 30 gals. of oil), and emulsifier	11.9	75.2
7. Diesel oil (1 part), water (1 part), 4 lbs. sulfur to 30 gals. of oil, and emulsifier	46.1	63.5
8. Diesel oil (1 part), water (4 parts), pentachlorophenol (4 lbs. to 100 gals. of oil), and emulsifier	35.2	54.1
9. No treatment	52.1	72.4

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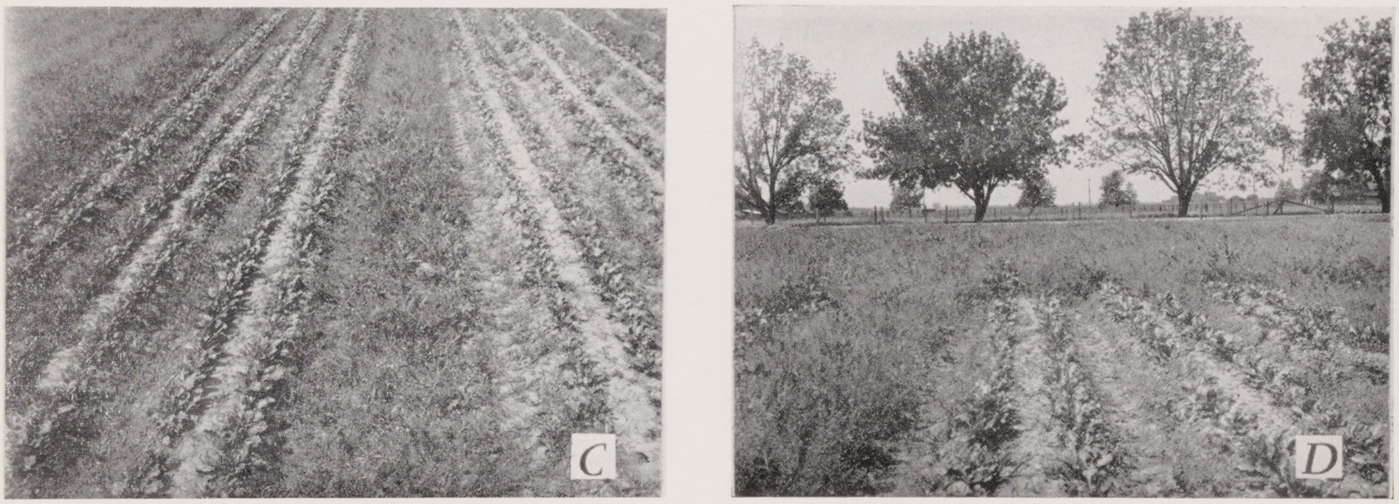
*Active ingredient, dinitro secondary butyl phenol. (Active ingredient of Sinox General, dinitro secondary amyl phenol.)



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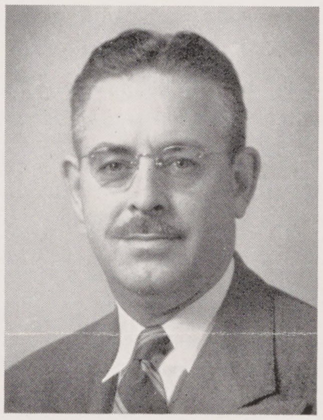
C, strip in the middle unsprayed, those on either side sprayed; D, plot in right foreground sprayed, surrounded by unsprayed plots. Plots neither cultivated nor irrigated. Photos taken about 45 days after spraying.

THE USE OF OILS FOR PRE-EMERGENCE WEEDING

By L. G. SMITH

Technical Products Department, Shell Oil Company, Incorporated



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Weeds have long been one of agriculture's most serious problems and one of the most promising solutions to this problem has been the use of chemicals.

As a result of many years of investigations various chemicals were developed for use as general contact herbicides. However, the use of some of these chemicals was restricted because of certain undesirable properties — some were extremely poisonous, some were highly flammable. The search for better general contact herbicides also led to the development of chemicals which were selective in their toxicity to various plants. As this new method of attack on the weed problem gained momentum, investigations turned into still another path—chemicals to be applied as pre-emergence sprays. It is this latter approach to weed control which is stressed in this discussion.

With the opening of the Shell Agricultural Laboratory at Modesto, California, in 1946, an immediate search was launched for weed control materials which would be more efficient, non-poisonous and safer than some commonly used in the past. Investigations were directed along three lines: (1) general contact herbicides especially effective on grasses such as Johnson, Bermuda as well as broad-leaved plants; (2) herbicides for selective weeding of crops such as carrots, celery, flax, onions and alfalfa; (3) herbicides for pre-emergence weeding of row crops such as sugar beets, carrots, spinach and onions.

The value as herbicides of such petroleum fractions as diesel fuel, stove oil and smudge pot oil has been known for some time. Investigations were undertaken to determine the properties of various petroleum fractions in relation to their efficacy as herbicides. It was found that the amount of unsaturated compounds and the volatility of the oil determined, to a large extent, its toxicity to plants.

These investigations led to the development of three new products possessing more of the desirable properties of oils for use as weed-killers: Shell Weedkiller No. 20, a general contact herbicide much more toxic than diesel fuel oil for weed control along roadsides, irrigation ditches, fence rows, etc.; Shell Weedkiller No. 10, a selective herbicide more efficient, yet safer, than stove oil for selective weeding of oil tolerant crops, such as carrots, celery and parsnips; and Experimental Shell Weedkiller No. 11, which shows promise as a selective herbicide for control of certain weeds in flax. Field tests carried out in various areas on the Pacific Coast resulted in widespread use of these newly-developed weedkillers during the current year.

In the spring of 1947, work was initiated on the development of pre-emergence sprays for sugar beets and carrots. In cooperation with the Spreckels Sugar Company, Shell's laboratory staff conducted experiments with pre-emergence sprays on sugar beets in the Delta area near Terminous, California. Five different materials were used, at various dosages, in replicated plots. The seed bed had been prepared several weeks in advance of planting to allow maximum germination of weed seeds. At the time of planting the weeds were about four inches high and a special effort was made not to disturb the soil any more than was necessary. Treatments were applied two days after planting. Shell Weedkiller No. 20, applied at 30 gallons per acre, and a Shell experimental concentrate used at a 10 per cent dilution in water applied at 55 gallons per acre and at a 5 per cent dilution in water applied at 90 gallons per acre gave excellent control of mustard, wild radish, smartweed (kelp), annual chickweed, pigweed, lambs'-quarter, watergrass and knotweed.

Table I shows the degree of control obtained with several of the materials.

TABLE I. RESULTS OF PRE-EMERGENCE SPRAYING OF SUGAR BEETS FOR WEED CONTROL

Materials	Dosage Per Acre	Per Cent Control of Weeds
Shell Weedkiller No. 20	30 Gals.	98
10% Dilution of Shell Experimental Concentrate . .	55 Gals.	97
5% Dilution of Shell Experimental Concentrate . .	90 Gals.	97
Diesel Fuel	60 Gals.	95
Diesel Fuel	35 Gals.	75

Experiments on pre-emergence weeding of carrots were made on Shell's experimental farm which is operated in conjunction with the agricultural laboratory. Stove oil and a 5 and 10 per cent dilution of Shell experimental concentrate in water were used, at different dosages, in replicated plots. Because of the sandy-type soil, carrots had to be irrigated up. Treatments were applied one week after planting. The weeds had grown to a height of approximately one inch. Excellent control of mustard, pigweed, filaree and purslane was obtained.

Results of these experiments are shown in Table II.

TABLE II. RESULTS OF PRE-EMERGENCE SPRAYS FOR WEED CONTROL ON CARROTS

Materials	Dosage Per Acre	Per Cent Control of Weeds
5% Dilution of Shell Experimental Concentrate . .	65 Gals.	98
10% Dilution of Shell Experimental Concentrate . .	43 Gals.	98
Stove Oil	65 Gals.	95
Stove Oil	43 Gals.	80

Promising results in selective weeding of alfalfa with Shell Weedkiller No. 20 have also been obtained when applied during the dormant season for general weed control and after the second and third cuttings for control of sandbur.

Further experiments on pre-emergence spraying for weed control are continuing at the Shell Agricultural Laboratory on sugar beets, carrots, onions, asparagus, spinach, direct-seeded cole crops and tomatoes.

While these experiments are of a preliminary nature, they indicate that pre-emergency spraying on certain crops is feasible and offers some distinct advantages, namely:

1. It is less costly than hand weeding. The material costs are approximately $4.00 to $5.00 per acre, which accounts for a considerable saving when compared to the hand method of weeding.

2. It eliminates competition of weeds in early stages of seedling growth, resulting in more vigorous plants and a better stand.

3. It reduces the number of cultivations, a practice which brings additional weed seeds to the surface, where they can germinate.

4. In the case of carrots, it prevents certain rapid-growing weeds from reaching an advanced stage where they are difficult to kill with selective oil herbicides.

Progress made within the past few years on chemical weed control has been encouraging. It points to the possibility that the time may not be far away when another of man's hardest tasks, "back-breaking weeding," will succumb to the age of chemicals and machines.

* * *

FORTIFIED OILS FOR WEED CONTROL

By W. A. WESTGATE

West Coast Representative, Standard Agricultural Chemicals, Inc.

Many thousands of barrels of petroleum oils are used each year for various kinds of weed control purposes throughout the United States. At first, this use was primarily as a simple contact killer against annual weeds and grasses, along roadsides, ditch banks, railroad rights of way, firebreaks, around warehouses and the like.

In more recent years the use of oil for weed killing purposes has broadened considerably. We have seen, for example, the tremendous success in the use of stove oil or kerosene in the selective weeding of carrots, parsnips and celery. More recently, we have seen its use as a pre-emergence spray on onion fields. Now as the result of further researches the use of so-called pre-emergence sprays is destined to become far more general and may include such crops as sugar beets, peas, potatoes and many other of the seed and vegetable crops.

One of the major problems involved in the use of fuel oils for weed killing purposes has been its increased cost and its decreased effectiveness as a weed killer. It seems that as the chemists improve the fuel quality of an oil they at the same time decrease its herbicidal qualities. This situation has led to the interests in methods of fortifying oil in the hopes that we could not only produce a better weed killer but also a cheaper one.

The sulphur content of oil has long been known to be one of the desirable constituents for weed killing purposes. This has led to the practice of adding elemental sulphur to the oil to increase its effectiveness. Pentachlorophenol and dinitro-cresol also were one of the earlier chemicals employed for this same purpose and are still being used. More recently, two new chemicals, namely dinitro-amylphenol and dinitro-butylphenol, have found considerable favor as oil fortifiers. This is because of their ready oil solubility, their great herbicidal qualities and relatively low costs. Two proprietary materials sold contain 75% and 55%, respectively, of the chemical.

One of the first uses for fortified oils employing the two dinitro compounds mentioned above was a large seed grower, the Waldo Rhonert Seed Company at Santa Rosa, California. In the past four years they have treated by this method about a thousand acres annually of onions and beet seed plantings. The onions are planted as bulbs and are treated soon after being set out or up to the time the green shoots attain a length of 2 to 4 inches. The beets are planted as the roots and are treated after the foliage has attained such a growth as to cover the crown of the root and thus afford it protection from the spray. One to two pounds of the active dinitro chemical is dissolved in 15 gallons of diesel oil and applied to the acre. The applications are made by means of an airplane, although ground equipment can be employed where conditions are favorable and if more desirable.

Considerable interest in fortified oil was shown last season commercially by alfalfa growers in California. They were used for the eradication of various winter annual weeds, such as fox tail, seedling rye grass, yellow star thistle and mustard in established stands of alfalfa. For this purpose about 28 ounces of the active dinitro compound is dissolved in 30 to 50 gallons of diesel oil and used per acre. In some cases water may be added to the above to insure adequate coverage employing 100 to 125 gallons per acre of the total emulsion. In Central California the application is made during the dormant season for alfalfa—namely, the latter part of December and January.

Of particular interest to sugar beet growers are the results obtained last season on the Bernell Harlan ranch in Yolo County. About 80 acres planted to sugar beets were sprayed prior to emergence. Part of this program included the use of Diesel oil fortified with Sinox General at the rate of one quart per 20 gallons of oil per acre.

One of the advantages of using fortified oils is that it makes it possible to considerably reduce the volume of oil or liquid that is normally required per acre. Thus, airplanes may be conveniently used, particularly for pre-emergence sprays where the weed foliage is very small and only 10 to 20 gallons of spray are used per acre. It also brings up the question of suitable nozzles and equipment for making low volume applications by means of ground power sprayers. Such nozzles have recently been perfected.

It has been found by many years of experience that high spray pressures, such as used in orchard practice, are not desirable for weed work. The best type of spray for weed control is a penetrating, low-pressure spray (40 to 150 lbs. pressure, depending upon nozzle orifice size) with the least tendency to fog or drift. The most efficient coverage is obtained from nozzles that discharge a fan-shape pattern. For low volume work (5 to 25 gallons per acre) the nozzles should not be spaced over 12 inches apart, as one should get as close to the weeds as practical to avoid drift. One hundred per cent overlap (double coverage) having alternate sprays meeting, is most desirable. This not only gives a more uniform distribution but also eliminates the possibility of leaving unsprayed strips. Double coverage is accomplished by staggering the nozzles on opposite sides of the boom and by adjusting its height so that the edges of alternate sprays just meet at the weed level. For spray booms with the nozzles spaced 12 inches apart, this is accomplished at a height of 14½ inches above the foliage with nozzles giving an 80° angle of spread. On booms with the nozzle spaced 15 inches apart, the boom should be 18 inches above the weed level; with nozzles 18 inches apart the height must be 21½ inches.

For the convenience of growers who may wish to get some idea of the correct nozzle sizes and pressures for field work, the table below has been prepared. In a num-

(Continued on next page)

ber of instances choices could have been made in nozzle sizes and pressures. Those given are believed to be the most desirable from the standpoint of spray velocity and the elimination of fogging.

DISCHARGE PER NOZZLE, ORIFICE SIZE (NOZZLE NUMBER) AND PRESSURE NECESSARY TO OBTAIN REQUIRED VOLUME PER ACRE AT DIFFERENT FIELD SPEEDS

Speed of Travel→	1 M.P.H.			2 M.P.H.			3 M.P.H.			4 M.P.H.			5 M.P.H.		
Gallons Per Acre Desired	Gallons Per Minute	Nozzle No.	Pounds Pressure	Gallons Per Minute	Nozzle No.	Pounds Pressure	Gallons Per Minute	Nozzle No.	Pounds Pressure	Gallons Per Minute	Nozzle No.	Pounds Pressure	Gallons Per Minute	Nozzle No.	Pounds Pressure
(Nozzles spaced 12″ apart)															
5	.01	—	—	.02	—	—	.030	—	—	.04	—	—	.05	20	40
10	.02	—	—	.04	—	—	.060	20	60	.08	22	65	.10	25	60
15	.03	—	—	.06	20	60	.090	22	90	.12	25	35	.15	32	60
20	.04	—	—	.08	22	65	.120	25	85	.16	32	65	.20	32	100
25	.05	20	40	.10	22	100	.150	32	60	.20	32	100	.25	32	120
50	.10	25	60	.20	32	100	.303	39	60	.40	39	110	.50	46	95
100	.20	32	100	.40	39	110	.61	59	65	.81	59	110	1.01	67	100
(Nozzles spaced 15″ apart)															
5	.01	—	—	.02	—	—	.04	—	—	.05	20	40	.06	20	50
10	.03	—	—	.05	20	40	.08	22	65	.10	25	60	.13	25	110
15	.04	—	—	.07	22	50	.11	25	70	.15	32	60	.18	32	80
20	.05	20	40	.10	25	60	.15	32	50	.20	32	100	.25	32	120
25	.06	20	60	.13	25	100	.19	32	70	.25	32	120	.32	39	70
50	.13	25	100	.25	32	110	.39	39	100	.50	46	95	.63	59	80
100	.25	32	110	.51	46	100	.76	59	100	1.01	67	100	1.27	78	90
(Nozzles spaced 18″ apart)															
5	.02	—	—	.03	—	—	.05	20	40	.06	20	50	.08	22	65
10	.03	—	—	.06	20	60	.09	22	90	.12	25	85	.15	32	60
15	.05	20	40	.09	22	90	.14	25	110	.18	32	80	.23	32	120
20	.06	20	60	.12	25	85	.18	32	80	.24	32	110	.30	39	60
25	.08	22	65	.15	32	50	.23	32	120	.30	39	60	.38	39	100
50	.15	32	50	.30	39	60	.45	46	65	.60	59	70	.76	59	100
100	.30	39	60	.61	59	75	.91	67	80	1.21	78	85	1.52	78	125

NOTE:

1. Nozzles numbers 20, 22, 25 and 32 refer to ''Monarch'' Fig. H-564 calibrations; all others refer to ''Monarch'' Fig. 624. Other flat spray nozzles similarly accurately milled are equally satisfactory.
2. The nozzle number refers to the diameter of the orifice in thousandths of an inch.

EQUIPMENT FOR PRE-EMERGENCE SPRAYING OF SUGAR BEETS

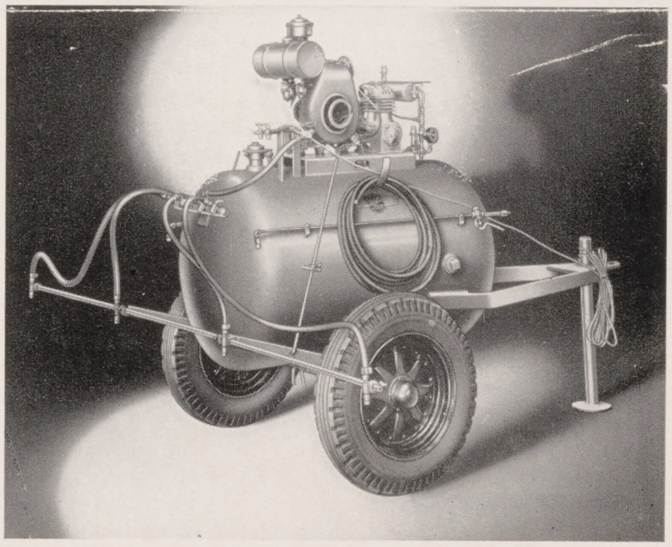
By A. P. GIBBO

Essick Manufacturing Company

Several types of power sprayers are now being used for pre-emergence spraying for control of weeds in various field crops. The most commonly used are gear, vane, centrifugal, piston and air pressure pumps. An example of the latter is the Essick Air-Power Sprayer, which has been used extensively throughout the West for weed control in citrus groves, vineyards and many field crops. This sprayer has been found to be well adapted for pre-emergence spraying of sugar beets because of its compactness and light weight.

The outstanding feature of the air-power sprayer is that when using air pressure the spray solution does not contact any moving part. This feature eliminates the wear caused by abrasive and non-lubricant materials encountered in liquid type pumps. A pressure of about 80 pounds per square inch is maintained on the solution. The material tanks are pressure tight and are equipped with air jet type agitators. Mechanical agitators are available when the spray material contains suspended solids. The material tank sizes vary from 65 to 300 gallons capacity and in spraying capacities from 4 to 17 gallons per minute. Spray booms are available from 9 to 35 feet in width and can be folded for going through gates or highway travel. Spray booms are adjustable from 6 inches to 30 inches in height. Spray nozzles are of the fan type and can be easily adjusted to obtain any width spray desired either for full coverage or over plant rows only. Various sizes of nozzles are available to obtain a great variation of gallons per acre application, according to tractor speeds, etc. Spray material to boom is controlled by a newly developed ratchet type single rope remote control valve.

Many sprayers already used by the grower for insecticide purposes may be used for pre-emergence spraying providing the material pressure is cut down to approximately 75 to 100 pounds per square inch. When insecticide sprayers are used for applying most weed killing chemicals, it is very important that the spray tank, boom, lines and guns be thoroughly cleaned before re-using for insecticide purposes, as even small traces of some weed control chemicals can do great damage to emerged sugar beets and other plants.



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Essick Air-Power Sprayer, Model 700

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SPRECKELS SUGAR BEET BULLETIN

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Incorporated August 6, 1897

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San Francisco 11, California

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SPRECKELS SUGAR COMPANY FACTORIES

	SPRECKELS CALIFORNIA	MANTECA CALIFORNIA	WOODLAND CALIFORNIA
Erected	1899	1917	1937
Daily Capacity (Tons of Beets)	5,300	1,875	2,350
Superintendent	Ira A. Resch	A. A. Norman	W. W. Conner

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